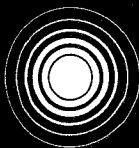


MODEL D600

18



LOWREY®

SERVICE MANUAL

MX-1

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SPECIFICATIONS



LOWREY MX-1, Model D600

A completely solid state, self-contained console organ with two 49-note keyboards and 18 pedals. The organ includes six amplifiers and seven full fidelity speakers:

Two 10-inch Bass Speakers (mounted in acoustic enclosure)

Two 6 x 9-inch Chorus Speakers

One 8-inch Main Speaker

Two 8-inch Flute Speakers

Dimensions

Height: 41-9/16 inches (1056mm)
(without Music Rack)

Width: 50-3/8 inches (1280 mm)

Depth: 28-3/4 inches (731mm)

Weight: 357 lbs. (162kg)

SPECIFICATIONS

UPPER

PRESETS

TROM BONE 16	CLARI- NET 16	CORNET 16	KINURA 8	FLUTE 16	FLUTE 8	FLUTE 5 1/3	FLUTE 4	FLUTE 2 2/3	FLUTE 2	FLUTE 1	UPPER FLUTE PRESET	CUSTOM FLUTE PRESET
Schematic 7						Schematic 4					Sch 4 & 8	

FLUTE 5-1/3

No sustain, Golden Harp or AOC effect.
Keys tone 7 keys to right of 8-foot tone
(i.e. 5-1/3-foot G same tone as 8-foot D)

FLUTE 2-2/3

No sustain, Golden Harp or AOC effect.
Keys tone 7 keys to right of 4-foot tone
(i.e. 2-2/3-foot G same tone as 4-foot D)

FLUTE 1

C#4 to C5 repeat C#3 to C4 tones.

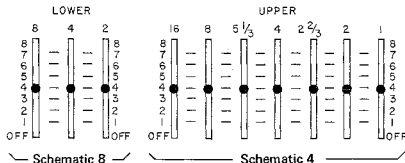
UPPER FLUTE PRESET

Factory set to select 16-, 4-, 2-2/3- and 2-foot
Flutes.
Does not disable other Flute tabswitches.

CUSTOM FLUTE PRESET

Enables Custom Flute Preset Slider Pots for
customizing Upper and Lower Keyboard Flutes.
Disables Upper Flute Preset and Upper Flute
tabswitches.

CUSTOM FLUTE PRESET



Schematic 8

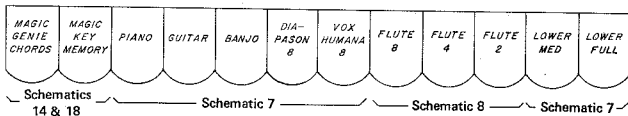
Schematic 4

These Slider Pots control the volume level of all the flute footages on upper and lower manual when Custom Flute Preset tabswitch is on.

(Note: Due to fundamental and harmonic enhancement or suppression,
Reed and String sounds can be created by these sliders.)

SPECIFICATIONS

MAGIC GENIE/LOWER



MAGIC GENIE CHORDS

Causes chords to be constructed from one keydown. Chords can be minored, augmented, diminished or 7th added in same manner as for Orchestration Plus. Chords hold until all keys are released and any key is re-keyed. The effect of this tabswitch on Orchestration Plus is the same as the Chord Logic button.

MAGIC KEY MEMORY

Causes Lower Keyboard keys to hold until all keys released and any key is re-keyed. The effect of this tabswitch on Orchestration Plus is the same as the Chord Logic button.

PIANO GUITAR BANJO

Modulated at Rhythm Speed with Rhythm on. Volume controlled by Genie Slider Pot.

LOWER MED. LOWER FULL

Control volume of Lower R/S and Flute voices except Piano, Guitar and Banjo.

SPECIFICATIONS

ORCHESTRAL PERCUSSION

4 HARMONIC 2-2/3 BELLS



VIBES

VIBRA

CHIMES



ACCORD
ION

HAWAIIAN
GUITAR

VIOLIN



Switches: Schematic 18

LED's: Schematic 16

Filtering: Schematic 7

Harmonic 4, 2-2/3 and Bells presets do not cancel each other, but when selected will cancel any previously selected preset in the bottom two rows. Selecting a preset in the bottom two rows will cancel any previously selected presets in this section.

HARMONIC 4

4-foot Flute voice with percussive envelope

HARMONIC 2-2/3

2-2/3-foot Flute voice with percussive envelope

BELLS

4-foot Percussive Flute voice with strike tone

VIBES

16-foot Flute voice with tremolo and percussive strike tone attack

VIBRA HARP

16-foot Flute voice with tremolo

CHIMES

Combination of 4 - 4-foot Flute tones with percussive envelope.

Chimes cancels upper tabs witch voices, and can be played only from G2 to C5 on Upper Keyboard.

ACCORDION

16-foot R/S voice with Slow Attack envelope

HAWAIIAN GUITAR

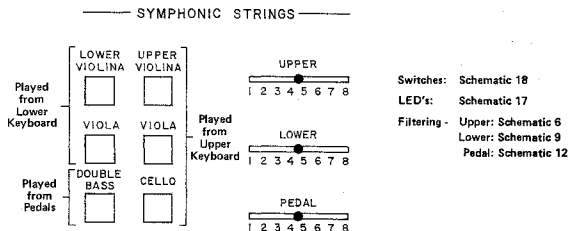
A phase modulated 8-foot R/S voice.

VIOLIN

A phase modulated 4-foot R/S voice.

The volume for the Orchestra! Percussion Presets is controlled by the Percuss Control in the Effects Potentiometer section.

SPECIFICATIONS



All presets in this section do not cancel each other, and are phase modulated by the three channel chorus circuit on Schematic 11.

LOWER VIOLINA

4-foot Lower Keyboard String voice, Volume Controlled by Lower Slider.

UPPER VIOLINA

4-foot Upper Keyboard String voice, Volume Controlled by Upper Slider.

LOWER VIOLA

8-foot Lower Keyboard String voice, Volume Controlled by Lower Slider.

UPPER VIOLA

8-foot Upper Keyboard String voice, Volume Controlled by Upper Slider.

DOUBLE BASS

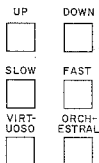
16-foot Pedal Keyboard String voice, Volume Controlled by Pedal Slider.
Will not play if an Orch. Plus style is being used.

UPPER CELLO

16-foot Upper Keyboard String voice, Volume Controlled by Upper Slider.

SPECIFICATIONS

GOLDEN HARP



Switches: Schematic 18

LED's: Schematic 16

The Golden Harp feature plays a continual arpeggio or virtuoso pattern through the Upper Keyboard (Schematic 3) or Orchestral Symphonizer (Schematic 22) keying circuitry. The notes that comprise these patterns are calculated by the microprocessor from Lower Keyboard keydown information. The speed of the Harp is controlled by the Digital Rhythm Speed control and the Fast/Slow pushbuttons in this section. This feature can be activated by the Golden Harp/Minor Footswitch on the right hand side of the expression pedal. If the Magic Genie chord tabswitch is on, the Golden Harp/Minor Footswitch functions as a Minor switch and Golden Harp is activated when selecting the Up and/or Down pushbuttons.

Up-Down - causes arpeggio or virtuoso pattern to progress in an upward or downward direction. If both pushbuttons are selected, the pattern progresses Up and Down.

Slow - the speed slows to 1/2 of the Digital Rhythm Speed Display.

Fast - the speed is twice that of the Digital Rhythm Speed Display.

If both Slow and Fast are selected, the speed equals that of the Digital Rhythm Display which is equivalent to both buttons being off.

Virtuoso - causes the Golden Harp arpeggio pattern to periodically reverse direction as it progresses in an upward or downward direction.

Orchestral - causes the Golden Harp effect to be transferred to the Orchestral Symphonizer voices if an Orchestral Symphonizer voice is also selected. When the Orchestral Golden Harp button is selected, the Orchestral Symphonizer voices cannot be keyed from the upper keyboard.

Note: Golden Harp will play on all the Orchestral Percussion voices except Harmonic 2-2/3. However, any of these voices that pass through the Percussion/Slow Attack Modulator IC1 (Schematic 7) will require an upper keyboard keydown before the Golden Harp effect is heard.

SPECIFICATIONS

EFFECTS

SUSTAIN UPPER	SUSTAIN LOWER	UPPER STRING ATTACK	MARIMBA REPEAT	VIBRATO
Sch 3	Sch 9	Sch 3	Sch 13	Sch 3

SUSTAIN UPPER

Enables Sustain Slider Pot for sustain length control of Upper Keyboard Tabswitch and Symphonic String voices and some Orch. Percussion presets.

SUSTAIN LOWER

Switches in fixed amount of sustain for Lower Keyboard tabs and Symphonic String voices.

UPPER STRING ATTACK

Gives Slow Attack effect to Upper Symphonic String voices Violina, Viola and Cello.

MARIMBA REPEAT

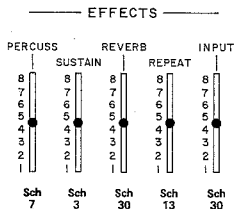
Causes an alternating repeat on Upper Tabswitch and all Orchestral Percussion voices except Bells (unless on with an upper tabswitch voice) and Chimes. Speed is controlled by Repeat control in Effects Potentiometer Section. If one key is held, tone will alternate with same key one octave lower.

Note: Orchestral Percussion voices with long Preset Sustain are not compatible with this effect.

VIBRATO

Gives Vibrato effect to Upper/Lower Keyboard Tabswitch and Symphonic String voices.

SPECIFICATIONS



PERCUSS

Controls volume of Orchestral Percussion voices.

SUSTAIN

Controls the sustain length of Upper Keyboard Tabswitch and Symphonic String voices and some Orch. Percussion Presets when the Sustain Upper tabswitch is on.

REVERB

Enables the Reverb effect and controls the Reverb length for all sections of the organ.

REPEAT

Controls the Repeat speed when the Marimba or Repeat Percuss tabswitch is on.

INPUT

Controls the input signal level of the Right and Left Auxiliary Input Jacks.

SPECIFICATIONS

--PERCUSSION-- --STEREOPHASE SOUND--

PERCUSS LONG	REPEAT PERCUSS	VIBRA TREM FLUTE	FLUTE CHORUS	MAIN CHORUS	CHORUS CELESTE
Sch 3	Sch 3 & 13	Sch 3, 10 & 30	Sch 10 & 30	Sch 30	Sch 10 & 11

PERCUSS LONG

Lengthens decay of Harmonic 4 and Harmonic 2-2/3 Orchestral Percussion voices. Keys must be held to hear effect.

REPEAT PERCUSSION

Causes Harmonic 4, Harmonic 2-2/3 and Bells in Orchestral Percussion section as well as Banjo and Mandolin voices in Orchestral Symphonizer section to key repeatedly at a rate controlled by the Repeat Slider Pot in effects control section. When selecting this tab all of the above buttons flash at the Repeat speed. The button selected lights steadily while the others continue to flash.

Note: Bells will have a Marimba repeat effect with this tab on. The Marimba Repeat tab will not effect bells unless on with an upper tabswitch voice.

VIBRA TREM FLUTE

Phase modulates all Flutes through the 2 channel chorus circuit on Schematic 10.

FLUTE CHORUS

Phase modulates all Flutes through the 2 channel chorus circuit on Schematic 10 and the 3 channel chorus circuit on Schematic 11.

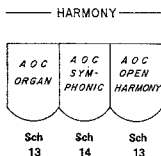
MAIN CHORUS

Phase modulates all main R/S voices through the 3 channel chorus circuit on Schematic 11.

CHORUS CELESTE

Slows chorus effect when the Main or Flute Chorus tabs are on.

SPECIFICATIONS



AOC ORGAN

Couples keys being played on Lower Keyboard to Upper Keyboard.
Gives the effect of playing full Upper Keyboard Chords with one finger. Lower Keyboard notes within three notes of the Upper Keyboard note played are not coupled. Effect can be used with all Upper Keyboard Tabswitch and Orch. Percussion voices except Chimes, Flute 5-1/3, Flute and Harmonic 2-2/3.

AOC SYMPHONIC

Same as AOC organ except effect is heard on Orchestral Symphonizer voices and the Wow & Orchestral voices of the Custom Symphonizer.

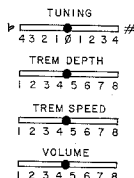
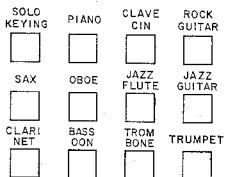
AOC OPEN HARMONY

Alters the coupling pattern when the AOC organ or AOC Symphonic Tabswitch is on. Lower Keyboard notes within five notes of the Upper Keyboard note being played are coupled to the Upper Keyboard an octave below the Upper Keyboard note being played.

SPECIFICATIONS

SOLO SYMPHONIZER

Buttons: Schematic 18
 LEDs: Schematic 17
 Keying &
 Filtering: Schematics 26 & 27



The Solo Keying button may be on with any selected preset in this section. All other buttons in this section and the Solo Button in the Custom Symphonizer Section cancel each other. Selecting a preset in this section disables the glide circuits of the Main and Orchestral Symphonizer Oscillators.

SOLO KEYING

When playing with both hands on Upper Keyboard, prevents lead or solo note from being re-assigned to highest left-hand key when right hand is clear of keyboard. For example, if the Sax voice is on with Solo Keying off, and C1 and C4 are being held on upper keyboard, C4 plays. If C4 is released, C1 will play. With Solo Keying on, if C4 is released C1 will not play.

PIANO*

Sawtooth Audio with Percussive Envelope.

CLAVECIN*

Pulse width modulated Audio with Percussive Envelope.

* With Piano or Clavecin on, the Glide Switch (left side of Expression Shoe) becomes key up sustain length control switch.

ROCK GUITAR

Pulse width modulated Audio with Percussive Envelope.

SAX

Pulse width modulated Audio with Slow Attack Envelope.

OBOE

Pulse width modulated Audio with Slow Attack Envelope.

JAZZ FLUTE

Combination of 4' & 8' Audio with Noise Signal.

JAZZ GUITAR

Pulse audio with percussive Envelope. Filtered by voltage controlled filter.

CLARINET

Square wave 16' Audio with separate keyer.

BASSOON

Pulse width modulated Audio with Slow Attack Envelope.

TROMBONE

Pulse width modulated audio with Slow Attack Envelope. Filtered by voltage controlled filter.

TRUMPET

Pulse width modulated audio with Slow Attack Envelope. Filtered by voltage controlled filter.

CONTROLS

Affect all voices of the Solo Symphonizer Section and the Solo Voice of the Custom Symphonizer.

TUNING

Varies frequency of Solo Symphonizer oscillator.

TREM DEPTH, TREM SPEED

Controls speed and amplitude of Solo Tremolo oscillator. (When Piano or Clavecin are on the Tremolo Oscillator is disabled and these controls have no effect.)

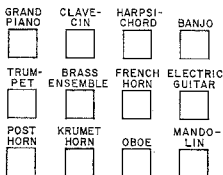
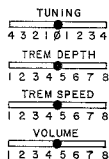
VOLUME

Controls amplitude of Solo Symphonizer Audio output.

Note: Only the highest upper keyboard note being held will sound the Solo voice.

SPECIFICATIONS

ORCHESTRAL SYMPHONIZER



Buttons: Schematic 18
LEDs: Schematic 17
Keying &
Filtering: Schematics 22-25

All buttons in this section and the Orchestral and Wow buttons of the Custom Symphonizer cancel each other.

GRAND PIANO*

Sawtooth Audio with Percussive Envelope and Chorus.

CLAVECIN*

Pulse Audio with Percussive Envelope and Chorus.

HARPSICHORD*

Pulse Audio with Strike Tone Audio, Percussive Envelope and Chorus.

* With Grand Piano, Clavecin or Harpsichord the Glide Switch (left side of Expression Shoe) becomes Key Up Sustain Length Control Switch. Also, the Main Glide circuit is disabled.

BANJO

Sawtooth Audio with detuning pulse and Percussive Envelope.

TRUMPET

Pulse Audio with Slow Attack Envelope. Filtered by voltage controlled filter.

BRASS ENSEMBLE

Pulse Audio with Slow Attack Envelope. Filtered by voltage controlled filter.

FRENCH HORN

Sawtooth Audio with Slow Attack Envelope and Deeper Chorus.

ELECTRIC GUITAR

Pulse Audio filtered by Electric Guitar filters. Percussive Envelope with Strike Tone Audio, Detuning Pulse and Chorus.

POST HORN

Pulse Audio with Slow Attack Envelope.

KRUMET HORN

Pulse Audio with Slow Attack Envelope.

OBOE

Pulse Audio with Slow Attack Envelope.

MANDOLIN

Pulse Audio with Percussive Envelope, Strike Tone Audio, Detuning Pulse and Chorus.

CONTROLS

TUNING

Varies frequency of Orchestral Symphonizer oscillator.

TREM DEPTH, TREM SPEED

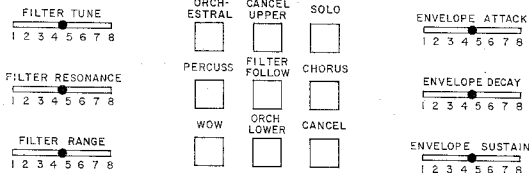
Controls speed and amplitude of Orchestral Tremolo oscillator. (When Piano, Clavecin, Harpsichord, Banjo or Mandolin on the tremolo oscillator is disabled and these controls have no effect.)

VOLUME

Controls amplitude of Orchestral Symphonizer Audio output.

SPECIFICATIONS

CUSTOM SYMPHONIZER



Buttons: Schematic 18

LEDs: Schematic 17

All buttons in this section are additive except Wow & Orchestral.

ORCHESTRAL

Can be considered an additional Orchestral Symphonizer Voice. (See Orchestral Symphonizer spec sheet.) Uses pulse audio that is filtered by the voltage controlled filter on Schematic 25. All controls of Custom Symphonizer and Orchestral Symphonizer will effect this voice.

WOW

Same as Orchestral voice except Custom Symphonizer Controls do not effect this voice.

SOLO

Can be considered an additional Solo Symphonizer voice. (See Solo Symphonizer spec sheet.) Uses pulse audio that is filtered by the voltage controlled filter on Schematic 27. All controls of Custom Symphonizer and Solo Symphonizer will effect this voice.

CANCEL UPPER

Cancels Upper Keyboard tabs witch voices if any Orchestral, Solo or Custom Symphonizer voice is on, or any Orchestral Percussion voice except Harmonic 4 or 2-2/3.

Note: If Orchestral Golden Harp is being played with no Orchestral Percussion, Solo or Custom Symphonizer voice on, pressing this button will not cancel upper tabs witch voices.

PERCUSS

Gives a Percussive Attack to the Orchestral or Solo voices of this section.

FILTER FOLLOW

When on with either the Solo or Orchestral voice, causes the tuning of the VCO filters (Schematic 25 for Orchestral and Schematic 27 for Solo) to follow the highest keyboard note being played.

CHORUS

Directs the Orchestral, Wow or Solo voice through the three channel chorus circuit.

ORCH TO LOWER

Allows the Orchestral Symphonizer voices to be played from the Lower Keyboard.

CANCEL

Cancels all buttons of the Orchestral, Custom and Solo Symphonizers. This button does not light when pressed.

CONTROLS

FILTER TUNE, FILTER RESONANCE, FILTER RANGE, ENVELOPE ATTACK, ENVELOPE DECAY, ENVELOPE SUSTAIN

The above controls effect the tuning envelope, used to drive the VCO filters on Schematic 25 for the Orchestral voice and Schematic 27 for the Solo Voice. These controls only effect the Orchestral and Solo voice of the Custom Symphonizer.

SPECIFICATIONS

DIGITAL STEREO RHYTHM

BALLAD	DIXIE	SWING	COUNTRY	SWING WALTZ	WALTZ
☐	☐	☐	☐	☐	☐
TANGO	SAMBA	BOSA NOVA	RHUMBA	CHA CHA	LATIN ROCK
☐	☐	☐	☐	☐	☐
ROCK	MARCH	SOFT ROCK	DISCO	POLKA	METRO NOME
☐	☐	☐	☐	☐	☐

Buttons: Schematic 18
LEDs: Schematic 16
Filtering: Schematics 28 & 29

All buttons in this section cancel each other. (See Rhythm Pattern Charts for specific instrumentation.)

Selecting an Orchestration Plus style causes one to four rhythm buttons to flash (see chart below), indicating recommended rhythm patterns for that style. Once a rhythm pattern is selected, the light for that rhythm lights steadily leaving the other recommended patterns flashing.

If the Orchestration Plus style is changed after selecting a rhythm pattern, the preferred rhythm pattern for the new style will automatically be selected.

Exception

Once the Waltz or Swing Waltz rhythm is selected, no subsequent Orchestration Plus style selections will cancel that rhythm pattern, but will merely flash recommended patterns.

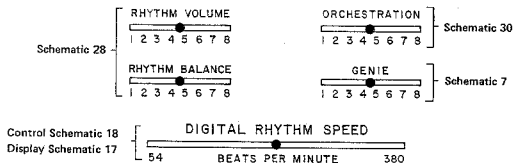
ORCH. PLUS RHYTHM SELECTION GUIDE

RHYTHM PUSHBUTTONS

ORCH. PLUS PATTERN	ROW 1					ROW 2					ROW 3				
	Ballad	Dixie	Swing	Country	Swing Waltz	Tango	Samba	Bosa Nova	Rhumba	Cha Cha	Latin Rock	Rock	March	Soft Rock	Disco
Big Band	*	X	X	X											
Contempo								X	X			*			
Polka															*
Country		*		X											
Jazz Guitar	X	X	*	X											
Rock												*	X	X	
Baroque								X				*			
Blue Grass	*		X												
Rhythm Guitar	*	X	X												
Disco														*	
Waltz					*	X									
Latin							X	*	X				X		

* Preferred Rhythm Pattern

SPECIFICATIONS



RHYTHM VOLUME

Controls amplitude of Rhythm Audio output.

ORCHESTRATION

Controls amplitude of Orchestration Plus Audio output.

RHYTHM BALANCE

Controls amplitude of Right and Left Channel Rhythm voices.

GENIE

Controls volume of Lower Keyboard Piano, Guitar & Banjo voices.

DIGITAL RHYTHM SPEED

This is a 24 position slider switch which determines speed of Rhythm and Orchestration Plus patterns. The beats per minute are shown on the Digital Rhythm Display.

POSITION—DISPLAY

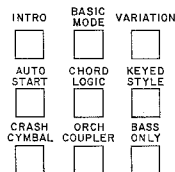
1	54
2	59
3	64
4	70
5	76
6	83
7	90
8	98
9	107
10	116
11	127
12	138

POSITION—DISPLAY

13	150
14	163
15	178
16	193
17	210
18	229
19	250
20	271
21	295
22	321
23	350
24	380

SPECIFICATIONS

PERFORMANCE EFFECTS



Buttons: Schematic 18

LEDs: Schematic 16

INTRO (DOWNBEAT)

Flashes red at downbeat when a Rhythm pattern is selected. When pressed, Rhythm pattern changes to Intro pattern and LED lights green for the duration of the Intro pattern, alternating red at downbeat. If an Orchestration Plus style is being played with Rhythm, only the bass portion of the Orchestration Plus style is heard during Intro. Selecting Intro with Rhythm off, has no effect on Orchestration Plus, but the Intro LED will light green until a Rhythm is selected and the Intro pattern plays.

VARIATION*

Alters Orchestration Plus styles by adding, subtracting or changing instruments within patterns. (See Orchestration Plus Style Description Chart.)

BASIC MODE*

Can be considered a second Orchestration Plus variation but only effects some styles. (See Orchestration Plus Style Description Chart.)

* Basic Mode and Variation cancel each other.

AUTO START

When selected, Rhythm and/or Orchestration Plus must be started by depressing a lower keyboard key. Upon key release, pattern will complete measure then stop.

CHORD LOGIC

When selected, chord changes for the Orchestration Plus will occur only when a new key-down is detected and not when keys are released. For example, assume a C minor chord (C1 & D#1) is being held with Chord Logic on. If the D#1 (minor) key is released the Orchestration Plus will continue to play a C minor chord. If Chord Logic was not on, a C major chord would play upon release of the D#1 key.

KEYED STYLE

Only Bass portion of Orchestration Plus style is heard until Lower Keyboard keys are pressed.

CRASH CYMBAL

Manually keys the crash cymbal when pressed. Does not light.

ORCH. COUPLER

With the Orch. Coupler on, it is possible to replace instruments in the Orch. Plus styles with any Orchestral Symphonizer voice selected. For example, if Bluegrass style is selected the Banjo is replaced by the selected Orchestral Symphonizer voice. Orchestral Symphonizer controls are ineffective when using this coupler, because the equivalent Orchestral Symphonizer voice is actually generated by the Orchestration Plus circuitry. Also the bass portion of the Orch. Plus style may be replaced at this time by selecting one of the Symphonic Bass pushbuttons.

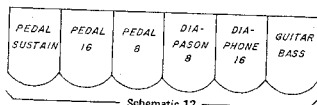
BASS ONLY

Only bass portion of Orchestration Plus is heard.

Note: This button lights when Bass Plus tabswitch is on.

SPECIFICATIONS

BASS



Pedal Tabswitch Voices are inoperative if an Orchestration Plus style is being used.

The Audio signal for these voices is produced by the Programmable Oscillator Peripheral IC29 on Orch. Plus Board 25B. Filtering and switching for these voices is shown on Schematic 12. These voices can be played from Lower Keyboard if the Genie Bass Tab-switch is on.

SYMPHONIC BASS

PIANO



BASS
FIDDLE



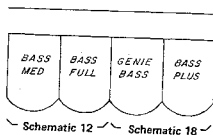
TUBA



Buttons: Schematic 18
LEDs: Schematic 16
Filtering: Voice Channel 6
of Orch. Plus
Schematic 21

Buttons in this section cancel each other and are inoperative if an Orchestration Plus style is being used.

These voices can replace the bass portion of the Orchestration Plus styles when the Orch. Coupler button in the Performance Effects section is on. Voices can also play on Lower Keyboard if the Genie Bass tab is on.



BASS MED, BASS FULL

Controls volume of Genie Bass, Orchestration Plus Bass and Pedals.

GENIE BASS

Allows the Pedal Tabswitch voices or the Symphonic Bass pushbutton voices to play on the Lower Keyboard. If a Rhythm is on the bass voice will alternate in a high low pattern. Playing a pedal will cancel Lower Keyboard bass.

BASS PLUS

Transfers Orchestration Plus control to Pedal switches and only Bass portion of Orchestration Plus is heard. Also causes Bass Only button in Performance Effect Section to light.

SPECIFICATIONS

— ORCHESTRATION PLUS —

BIG BAND	CONTEMPO	POLKA	COUNTRY
☐	☐	☐	☐
JAZZ GUITAR	ROCK	BAROQUE	BLUE GRASS
☐	☐	☐	☐
RHYTHM GUITAR	DISCO	WALTZ	LATIN
☐	☐	☐	☐

Buttons: Schematic 18
 LEDs: Schematic 16
 Filtering &
 Keying: Schematics 19,
 20 & 21

All buttons in this section cancel each other. Instruments and patterns vary for each style, depending on lower keyboard chord played and variation or basic mode selection. (See Scale and Chord Structure Chart in Chart section of manual.) If no chord has been selected before selecting an Orch. Plus style, a C major chord will play.

BIG BAND

A standard Dance Band - 5 Brass, 5 Saxes and a String Bass play accompaniment in the style of a Dance Band.

CONTEMPORARY

An Electric Guitar, Cello and Electric Bass play a contemporary soft rock style accompaniment.

POLKA

Trumpets, Trombones, Clarinets, Musette Accordion and Tuba play a polka accompaniment.

COUNTRY

A Steel Guitar, Piano, Acoustic Rhythm Guitar and String Bass play a country style accompaniment.

JAZZ GUITAR

An Electric Guitar and String Bass play a Jazz style accompaniment.

ROCK

An Electric Guitar and Electric Bass play a rock style accompaniment.

BAROQUE

A Harpsichord and Electric Bass play a three-part counterpoint accompaniment.

BLUEGRASS

A five-string Banjo, "Hoedown" Fiddle, Acoustic Rhythm Guitar and String Bass play a Bluegrass accompaniment.

RHYTHM GUITAR

An Acoustic Guitar and String Bass play straight rhythm accompaniment.

DISCO

A Clavinet, Brass Section and Electric Bass play a disco style accompaniment.

WALTZ

A full String Section and String Bass play a melodic accompaniment or an Acoustic Guitar and Bass play rhythm accompaniment.

LATIN

An Electric Guitar and String Bass play a Bosa Nova style accompaniment.

For more information on Orch. Plus styles, see "Description of Orchestration Styles Chart" and "Orchestration Plus Voice Channel Chart" in Chart Section of manual.

SPECIFICATIONS

GENERAL FEATURES

HEADPHONE - Schematic 31

Stereo Headphone Jack does not cancel speakers.

CANCEL SPEAKERS - Schematic 31

Mechanically latched pushbutton switch (Red Lens - Red LED) which cancels all internal speakers when lighted.

RIGHT- and LEFT-IN - Schematic 30

Stereo input to organ used for recorder playback. Input level controlled by input slider pot in Effects Controls section.

RIGHT- and LEFT-OUT - Schematic 31

Stereo output from organ used for input to recorder microphone jack.

CANCEL ACCOMP. - Switch, Schematic 18; Bulb, Schematic 16

Always lighted, cancels Orchestration Plus buttons, Rhythm buttons and any Magic Chord or Magic Memory notes that are playing.

SPOT LIGHTS, TAB LIGHT, PANEL LIGHTS - Schematic 32

Intensity controlled by three 3-position toggle switches.

PHOTOELECTRIC EXPRESSION PEDAL - Schematic 30

Controls volume of all organ channels.

POWER ON/OFF - Schematic 32

Three to four-second delay before speaker relay is activated.

IMPORTANT INFORMATION

SCHEMATIC DRAWINGS, PRINTED WIRING BOARDS

- 1) The numbering on each printed wiring board begins with Q1, IC1 and D1.
- 2) Board locations are clearly shown in large letters.
- 3) Two or more components with the same reference number may be drawn on the same schematic.
- 4) When components from two or more printed wiring boards are drawn on the same schematic, shaded areas will separate the components and their location will be clearly identified.
- 5) "S" numbers refer to socket numbers which are screened on PC boards. Pins in sockets are numbered from left to right or bottom to top as board is viewed in organ.
- 6) All tabswitches, pushbutton switches and keyswitches are shown "off" unless otherwise specified.

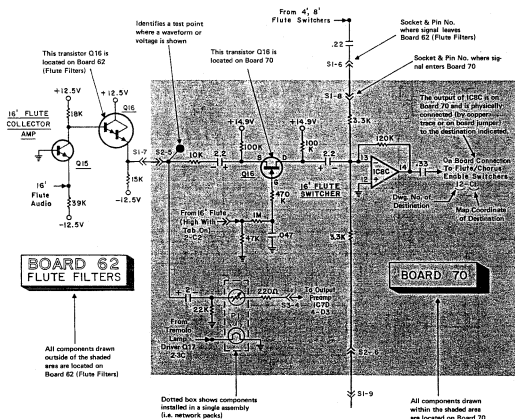
TEST EQUIPMENT

- 1) All voltages are measured with a Simpson 260 VOM to ground reference.
- 2) Oscilloscope waveforms are approximations.
- 3) Unless specified, measurements are made with keyswitches, tabswitches and pushbutton switches in the "off" position and controls at minimum.

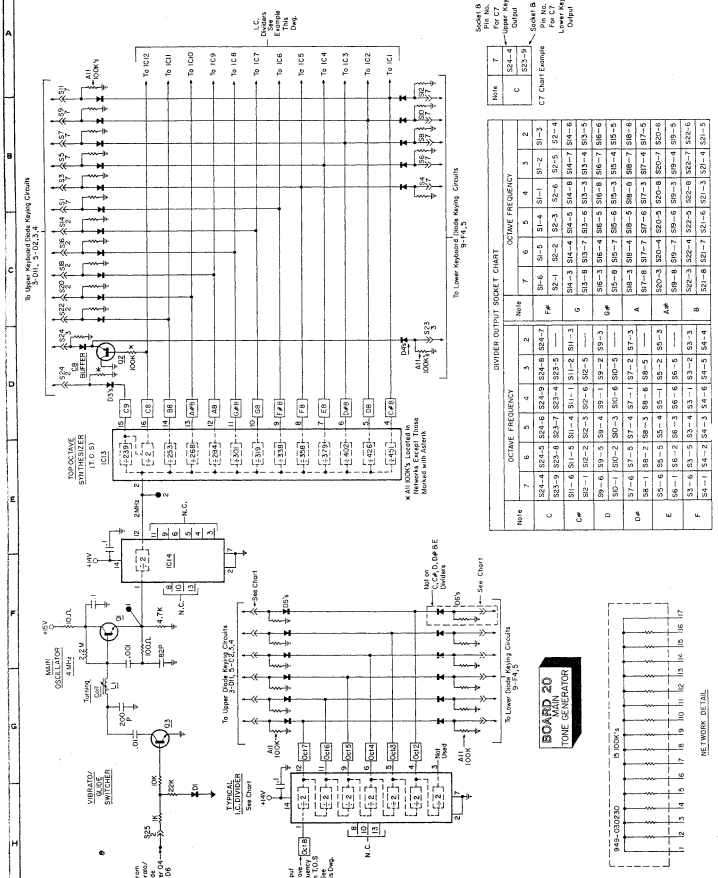
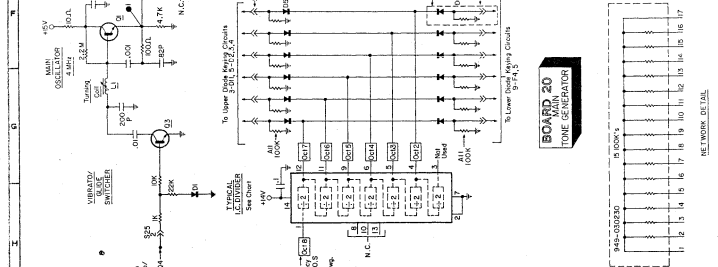
NOTE: Actual voltages and waveshapes will vary depending on the accuracy of your test equipment, loading, component tolerances, power supply voltages and other variables.

COMPONENTS

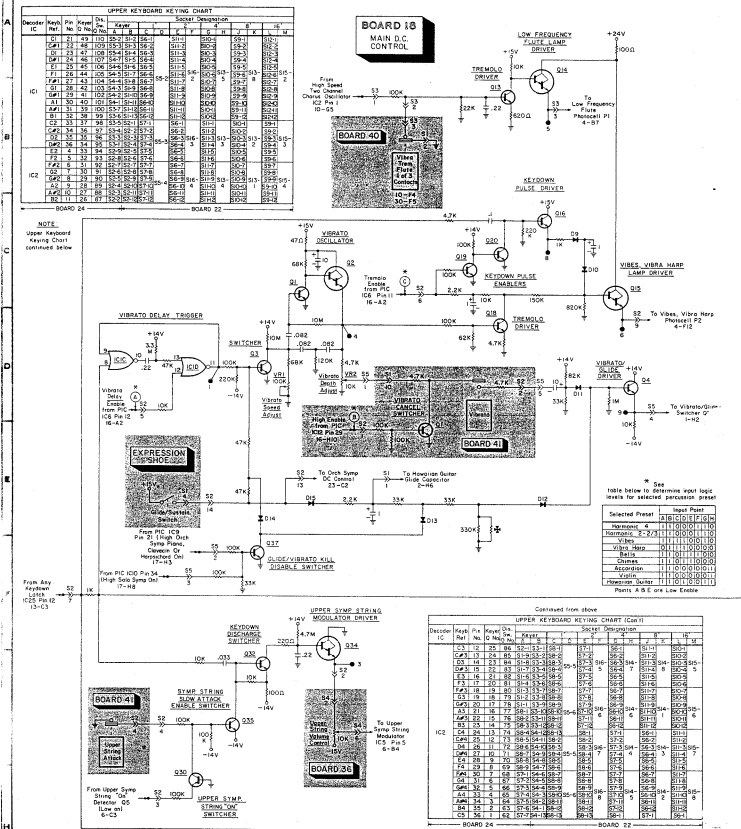
- 1) Resistors have 5 or 10% tolerances and are rated at 1/4 or 1/2 watt unless otherwise specified.
- 2) Capacitor values are in microfarads (uf) unless otherwise specified.
- 3) All components are located on indicated boards unless specified.
- 4) See Parts List for component part numbers.
- 5) ✱ Denotes factory-tailored component.
- 6) Resistors with "R" numbers and capacitors with "C" numbers are located in networks or listed in charts as indicated on individual drawings.



1	MAIN TONE GENERATOR	1
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[illegible]

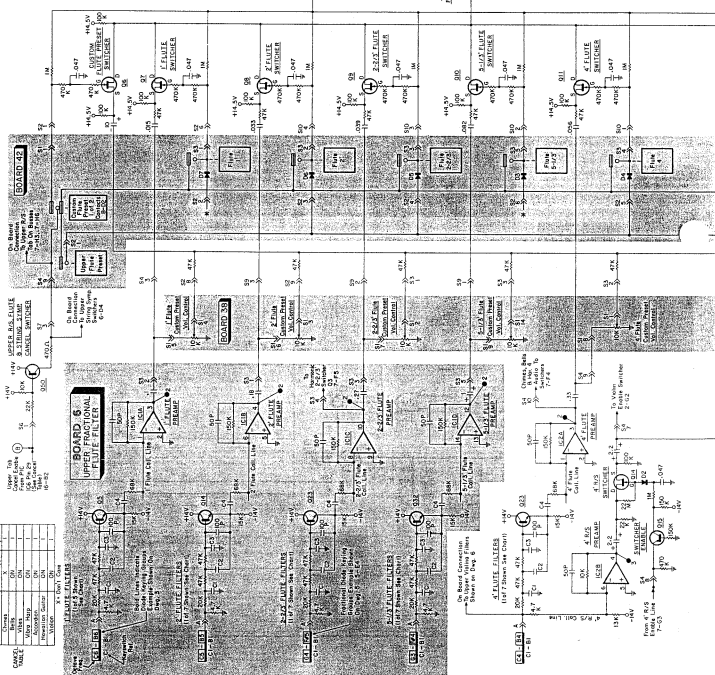
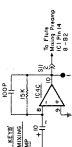




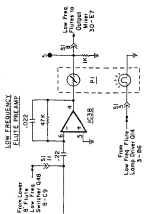
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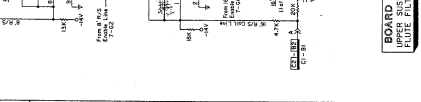
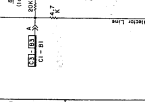
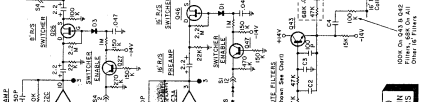
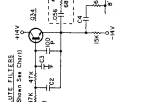
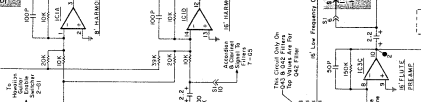
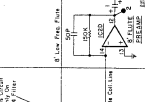
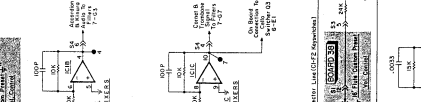
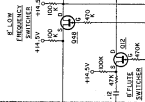
All Op Amps — $\begin{bmatrix} \text{pin 11} = +14\text{V} \\ \text{pin 7} = -14\text{V} \end{bmatrix}$



UPPER KEYBOARD FLUTE FILTERS



Complex	Ray	Order	Filter	Q1	Q2	C4
1	C-1-1	12-18	1-5	12552	1252	12519
	C-1-2	12-18	6-10	12552	1252	12519
	C-1-3	12-18	11-15	12552	1252	12519
2	C-2-1	12-18	1-5	12552	1252	12519
	C-2-2	12-18	6-10	12552	1252	12519
	C-2-3	12-18	11-15	12552	1252	12519
3	C-3-1	12-18	1-5	12552	1252	12519
	C-3-2	12-18	6-10	12552	1252	12519
	C-3-3	12-18	11-15	12552	1252	12519
4	C-4-1	12-18	1-5	12552	1252	12519
	C-4-2	12-18	6-10	12552	1252	12519
	C-4-3	12-18	11-15	12552	1252	12519
5	C-5-1	12-18	1-5	12552	1252	12519
	C-5-2	12-18	6-10	12552	1252	12519
	C-5-3	12-18	11-15	12552	1252	12519
6	C-6-1	12-18	1-5	12552	1252	12519
	C-6-2	12-18	6-10	12552	1252	12519
	C-6-3	12-18	11-15	12552	1252	12519
7	C-7-1	12-18	1-5	12552	1252	12519
	C-7-2	12-18	6-10	12552	1252	12519
	C-7-3	12-18	11-15	12552	1252	12519
8	C-8-1	12-18	1-5	12552	1252	12519
	C-8-2	12-18	6-10	12552	1252	12519
	C-8-3	12-18	11-15	12552	1252	12519
9	C-9-1	12-18	1-5	12552	1252	12519
	C-9-2	12-18	6-10	12552	1252	12519
	C-9-3	12-18	11-15	12552	1252	12519
10	C-10-1	12-18	1-5	12552	1252	12519
	C-10-2	12-18	6-10	12552	1252	12519
	C-10-3	12-18	11-15	12552	1252	12519



Note: Strike tone used only with Baris or Vias voices on.

STRIKE TONE KEYING CHART			
Decoder Pin No.	Key Ref.	Octave Keyed	Socket A
9	C	02	B8 594-1
10	C#	02	C8 594-2
11	D	02	D8 594-3
12	D#	02	E8 594-4
13	E	04	D#8 593-5
14	F	05	E8 593-6
15	F#	05	F8 593-7
16	G	06	F#8 593-8
17	G#	06	G8 593-9
18	A	09	G#8 594-4
19	A#	09	A8 594-5
20	B	01	A#8 594-2

FRACTIONAL FLUTE DECODERS

+23.5V

From Keyboard and
Strike Tone
Data From
IC27 Pin 3
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
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+23.5V

From Keyboard
Data From
IC4 Pin 10
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+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
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+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

From Keyboard
Data From
IC4 Pin 10
14-89

+23.5V

Octave Free Inputs
From Tone Gen.
1-IC1

432V

432V

432V

432V

432V

432V

432V

432V

432V

432V

432V

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432V

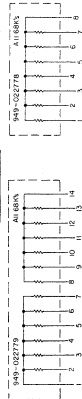
432V

432V

FRACTIONAL FLUTE KEYING CHART

Decoder IC		Key Ref.		Octave Keyed		Socket A	
Pin No.	Ref.	Pin No.	Ref.	Pin No.	Ref.	Pin No.	Ref.
1	C1	21	51-1	51	1	51	1
2	C#1	22	51-2	52	2	52	2
3	D1	23	51-3	53	3	53	3
4	D#1	24	51-4	54	4	54	4
5	E1	25	51-5	55	5	55	5
6	F1	26	51-6	56	6	56	6
7	F#1	27	51-7	57	7	57	7
8	G1	28	51-8	58	8	58	8
9	G#1	29	51-9	59	9	59	9
10	A1	30	51-10	60	10	60	10
11	A#1	31	51-11	61	11	61	11
12	B1	32	51-12	62	12	62	12
13	C2	33	52-1	63	13	63	13
14	C#2	34	52-2	64	14	64	14
15	D2	35	52-3	65	15	65	15
16	D#2	36	52-4	66	16	66	16
17	E2	37	52-5	67	17	67	17
18	F2	38	52-6	68	18	68	18
19	F#2	39	52-7	69	19	69	19
20	G2	40	52-8	70	20	70	20
21	G#2	41	52-9	71	21	71	21
22	A2	42	52-10	72	22	72	22
23	A#2	43	52-11	73	23	73	23
24	B2	44	52-12	74	24	74	24
25	C3	45	53-1	75	25	75	25
26	C#3	46	53-2	76	26	76	26
27	D3	47	53-3	77	27	77	27
28	D#3	48	53-4	78	28	78	28
29	E3	49	53-5	79	29	79	29
30	F3	50	53-6	80	30	80	30
31	F#3	51	53-7	81	31	81	31
32	G3	52	53-8	82	32	82	32
33	G#3	53	53-9	83	33	83	33
34	A3	54	53-10	84	34	84	34
35	A#3	55	53-11	85	35	85	35
36	B3	56	53-12	86	36	86	36
37	C4	57	54-1	87	37	87	37
38	C#4	58	54-2	88	38	88	38
39	D4	59	54-3	89	39	89	39
40	D#4	60	54-4	90	40	90	40
41	E4	61	54-5	91	41	91	41
42	F4	62	54-6	92	42	92	42
43	F#4	63	54-7	93	43	93	43
44	G4	64	54-8	94	44	94	44
45	G#4	65	54-9	95	45	95	45
46	A4	66	54-10	96	46	96	46
47	A#4	67	54-11	97	47	97	47
48	B4	68	54-12	98	48	98	48
49	C5	69	55-1	99	49	99	49
50	C#5	70	55-2	100	50	100	50

NETWORK DETAILS



BOARD 23
UPPER
FRACTIONAL
KEYER

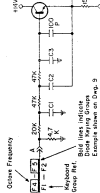




LOWER KEYBOARD FLUTE/DIAPASON FILTERS

BOARD 7 LOWER SUSTAIN FLUTE FILTER

LOWER 2' FLUTE FILTERS
(See 7' Show See Flute
Filter Chart)



Octave Frequency

10K

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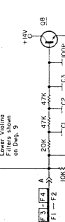
10K

10K

10K

BOARD 8 LOWER 4' FLUTE FILTERS

(See 7' Show See Flute
Filter Chart)



On Board

Lower 4' Flute

Filters shown

on 7' Show

See Flute

Filter Chart

10K

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BOARD 9 LOWER 4' FLUTE PREAMP

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BOARD 10 HARMONIC MIXER

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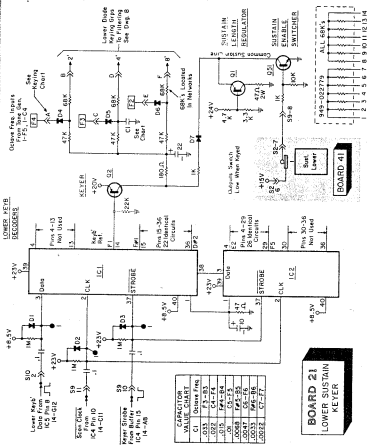
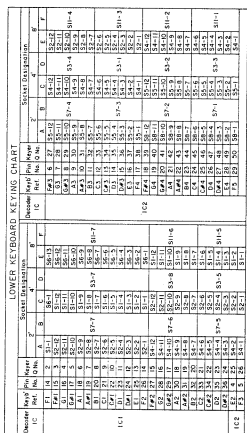
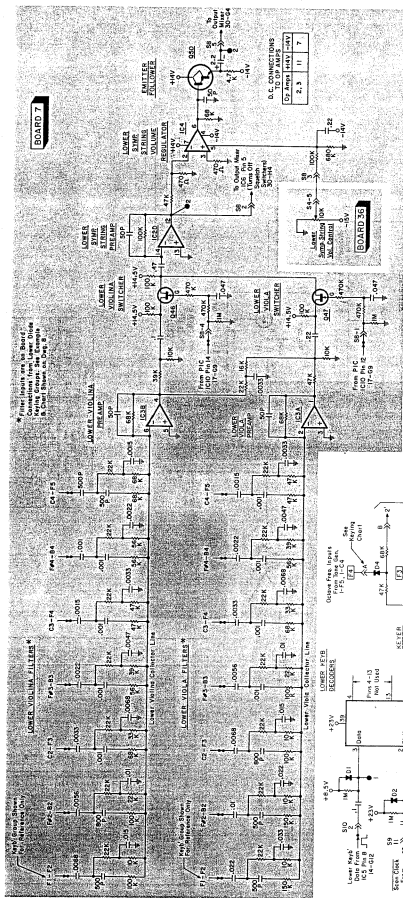
10K

10K

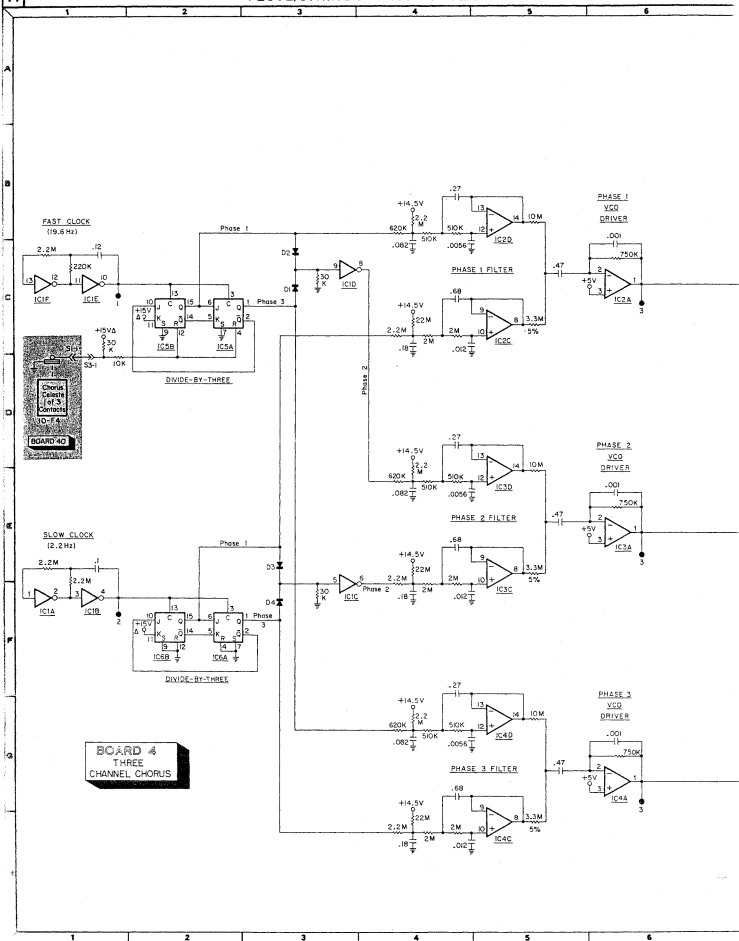
10K

10K

10K

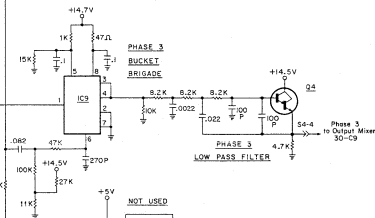
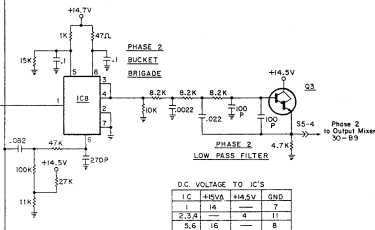
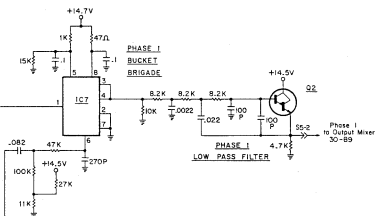
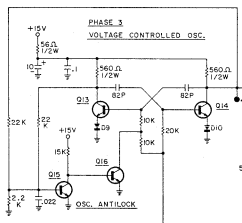
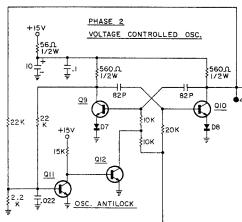
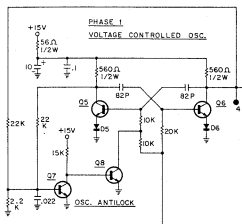


FLUTE/STRING CHORUS MODULATOR



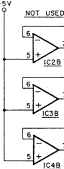
FLUTE/STRING CHORUS MODULATOR

11



D.C. VOLTAGE TO IC'S	IC	+15V	+14.5V	GND
1	14	—	7	—
2,3,4	—	4	11	—
5,6	16	—	8	—

From Flute/String
Chorus Audio Mixer
IC7 Pin 3
30-Hz



BOARD 4
THREE
CHANNEL CHORUS



BASS QUALITY CONTROL

12

DOUBLE
BASS/DIAPASON
KEYER



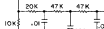
DOUBLE
BASS
SWITCHER



DOUBLE
BASS
PREAMP



DIAPASON 8' FILTER



DIAPHONIC 16' FILTER



16' PEDAL FILTER



8' PEDAL
KEYER



8' PEDAL FILTER



GIUITAR BASS FILTER



Orch. Plus
Voice 5 to Bass
Enable From
PIC IC35 Pin 29
30-HS



Orch. Plus
Voice 6 to Bass
Enable From
PIC IC35 Pin 29
30-HS



Orch. Plus
Voice 5 to Bass
Enable From
PIC IC35 Pin 29
30-HS



DIAPASON 8' SWITCHER



DIAPHONIC 16' SWITCHER



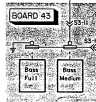
16' PEDAL SWITCHER



8' PEDAL SWITCHER



GIUITAR BASS SWITCHER



IC NO	+14V	-14V	GND
5	14	-	7

BOARD 19
PEDAL KEYER
& FILTER



KEYBOARD ENCODER I

13

- SCL = Scan Clock From IC4 Pin 2 14-100
- SCL = Inverted Scan Clock From IC3 Pin 4 14-80 (Disabled Time Pts. 64-96)
- BOS = Beginning Of Scan Stroke From IC4 Pin 6 14-A1
- BOS = Inverted Beginning Of Scan Stroke From IC5 Pin 2 14-B1
- 64/96 = Window, High Time Pts 64-96 From IC1 Pin 5 14-100

On Board Connection
from Golden Hump Enable
Line 14-24

Golden Hump Data
On Board Connection
from IC26 Pin 3
14-24

Upper Keyboard Data

BOARD 15 KEYBOARD ENCODER

* IC7, 12, 25 & 32 are "D" Flip-Flops with common
Clock & Reset Lines. Clock & Reset Connections are shown
on each section of these IC's for reference only.

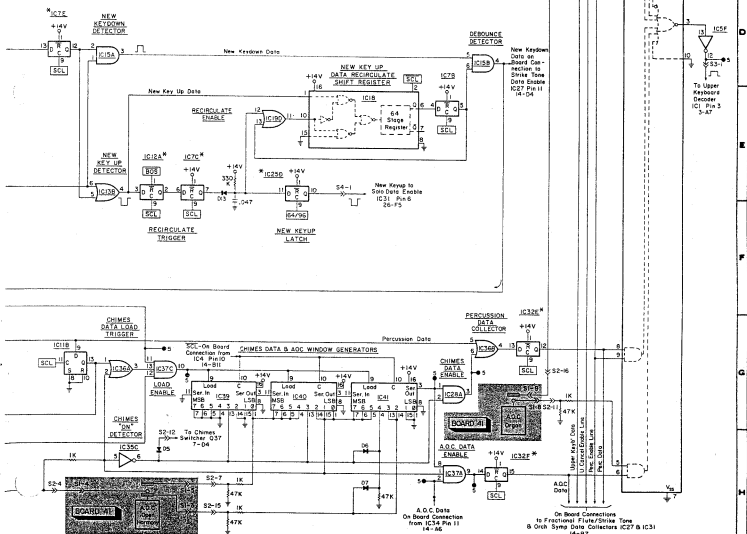
UPPER CANCEL & PERCUSSION ENABLE TRUTH TABLE									
Chimes	Cancel Upper Button	Any Sels Symm Button	Any Orch Symm Button	Orch To Lower Button	Bells	1/8 Max Taps & Sels String Buttons	Upper Cancel Enable Input (High Cancel)	PerCUSSION Enable Input (High Cancel)	
ON	ON	ON	—	—	—	—	0	1	
—	ON	—	—	—	—	—	0	0	
—	ON	ON	OFF	—	—	—	0	0	
—	—	—	—	—	ON	OFF	0	1	
—	ON	—	—	—	ON	—	0	1	
—	—	—	—	—	ON	ANY ON	1	0	

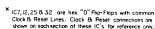
D.C. VOLTAGE TO IC'S
IC +14V GND
14-14 Pin 14 7
14-14 Pin 16 8

Percussion Enable from PIC
IC8 Pin 33 (See True Table)
This Dwg. Pts. 6-82

Percussion Enable Line
(High Enable)

PERCUSSION "ON"
UPPER & LOWER
A.O.C. DISABLE



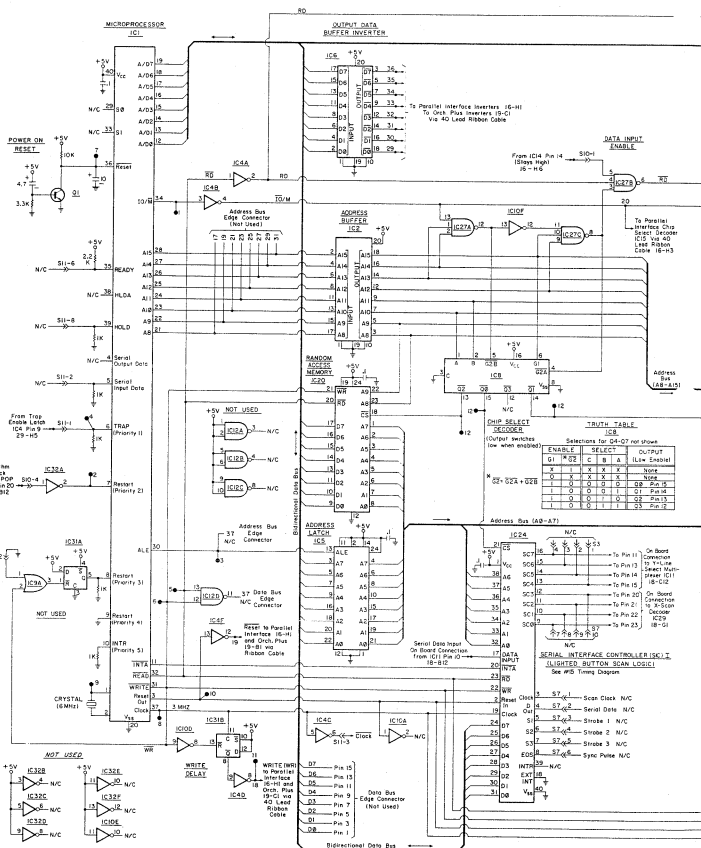


14



MICROPROCESSOR
ICI

OUTPUT DATA
BUFFER INVERTER





PARALLEL INTERFACE I

16

7

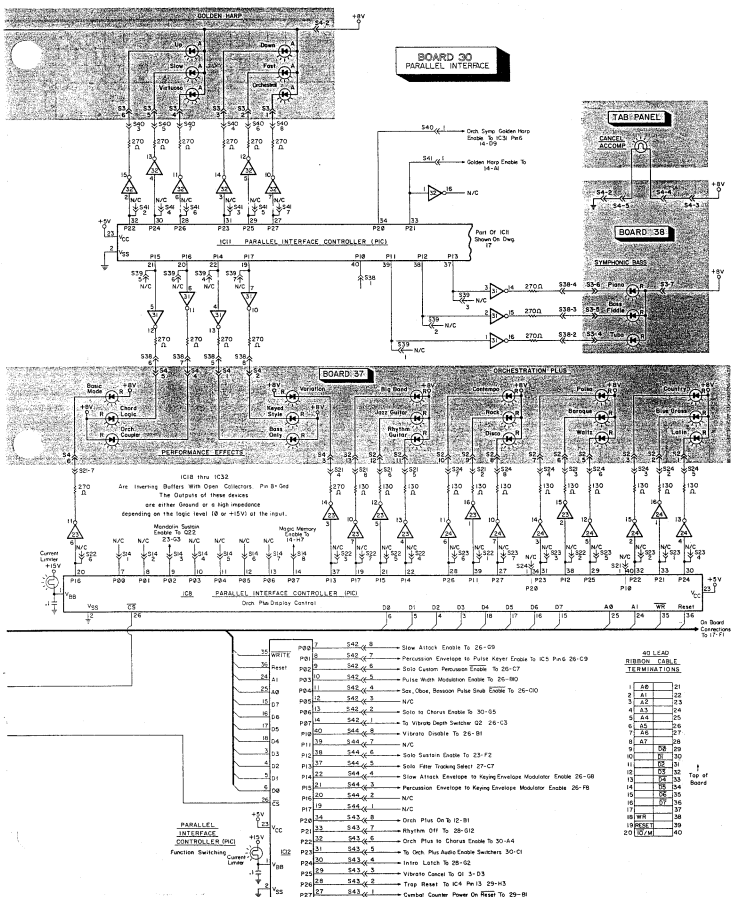
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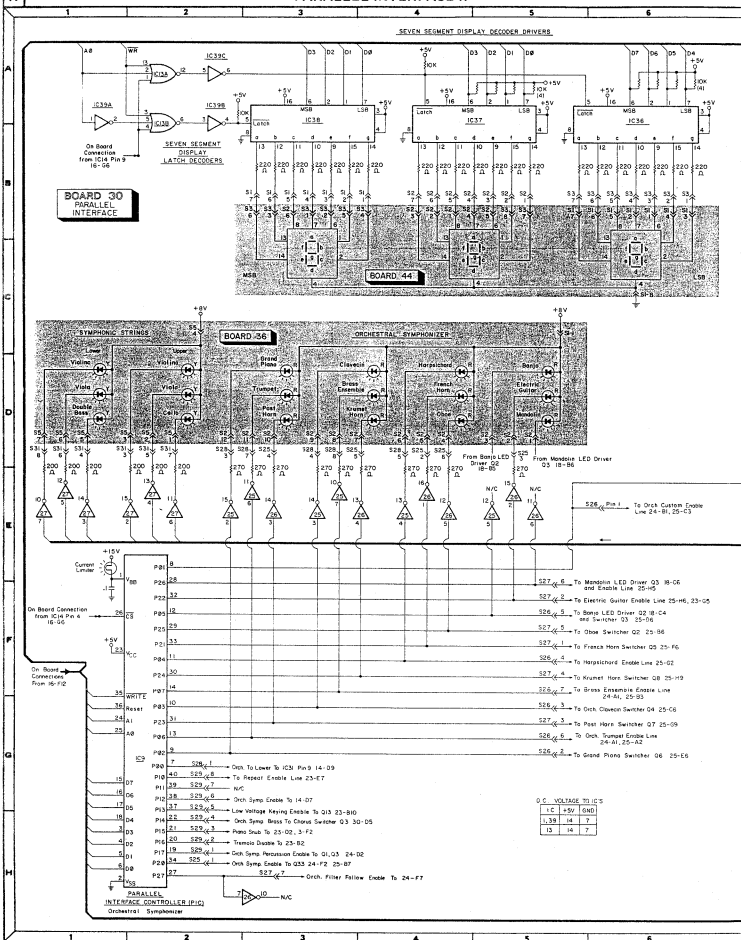
9

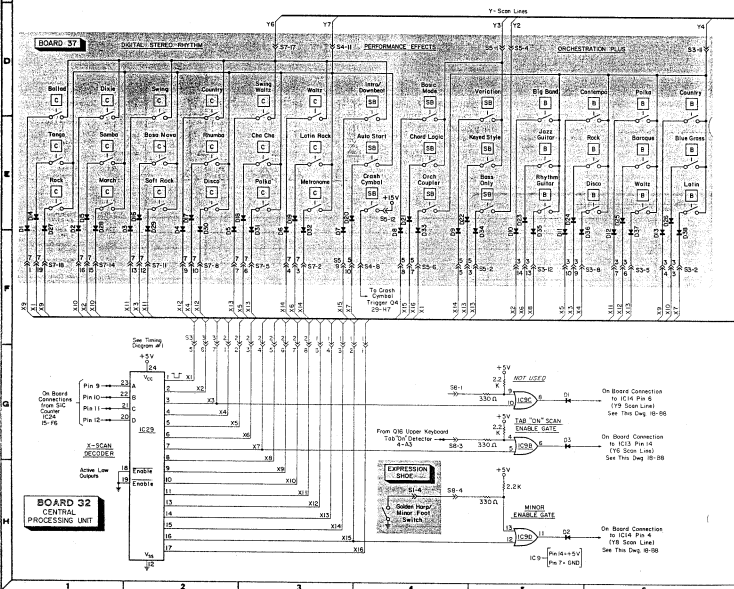
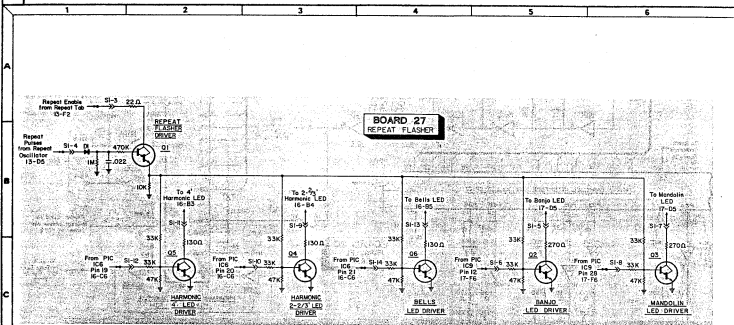
10

11

12



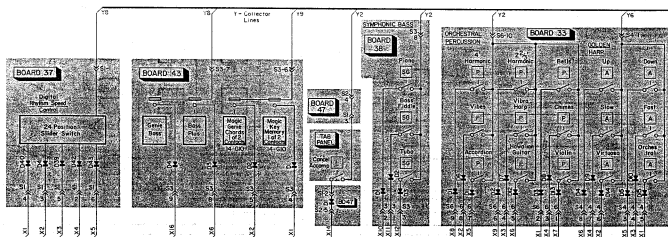
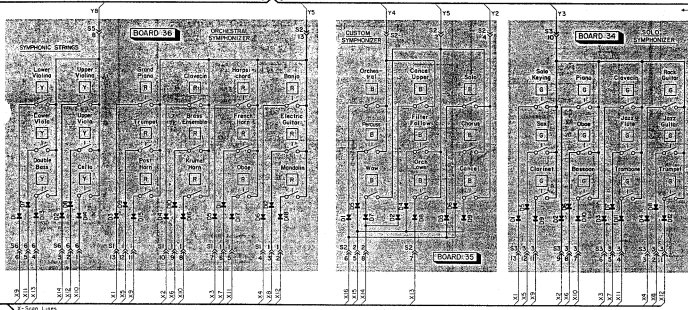
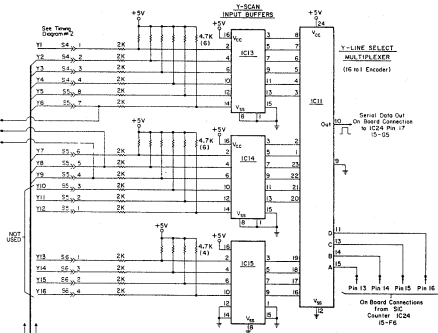




NOTE: Letter designates lens color

A	= Amber
B	= Blue
C	= Clear
G	= Green
P	= Purple
R	= Red
SB	= Smoke Brown
SG	= Smoke Gray
Y	= Yellow

All switches are Normally Open,
Momentary Contact unless
otherwise specified.



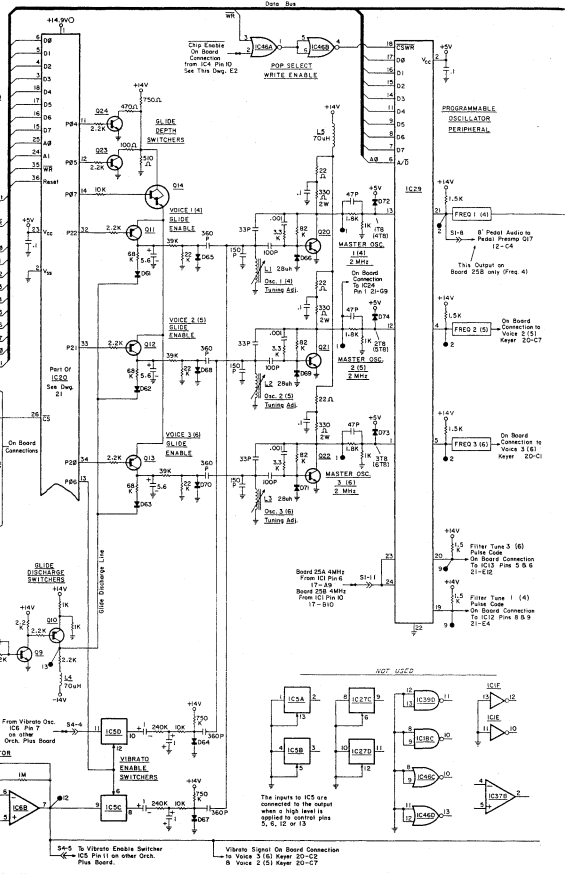
VOICE 1, 2, 3 on

BOARD 25A
ORCH PLUS 1

VOICE 4, 5, 6 on

BOARD 25B
ORCH PLUS 2From CPU
Use 40 Pin
Ribbon Cable
See Ribbon
Connector
Layout This
Dwg. G10PARALLEL
INTERFACE
CONTROLLER (PIC)Vib./Master
Osc. ControlOutputs toggle
between +15V
and GndDATA INPUT
INVERTING BUFFERSReset from
IC4 Pin 12
15-G3WR from
IC4 Pin 8
15-H3Data Inputs
from IC5
15-B4Address
Inputs
from IC5
15-D7ORCH PLUS
CHIP SELECT
DECODEBoard 25A
From IC15 Pin 6
16-16EBoard 25B
From IC15 Pin 5
16-16EDischarge
Pulse
Repulsion Rate
From IC10 Pin 8
17-C12

VIBRATO OSCILLATOR

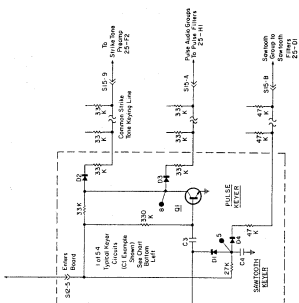


19







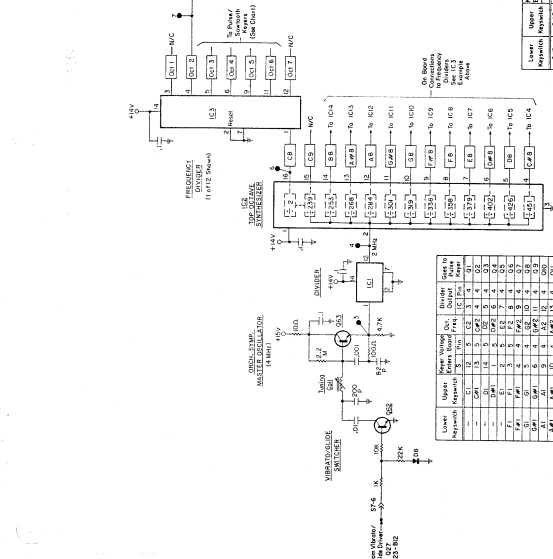


CAPACITOR SELECT			
Pulse Rate	Pin	Pin	Pin
Hz	A	B	C
01-06	00012	01	01
07-02	00012	01	01
03-08	00012	01	01
04-09	00012	01	01
05-00	00012	01	01
06-00	00012	01	01
07-00	00012	01	01
08-00	00012	01	01
09-00	00012	01	01
10-00	00012	01	01

SOCKET 15

OUTPUT CONNECTIONS			
Lower	Upper	Output	Pin
Key	Key	Key	A
Hz	Hz	Hz	B
01-01	02-02	03-03	04
01-02	03-03	04-04	05
02-03	04-04	05-05	06
03-04	05-05	06-06	07
04-05	06-06	07-07	08
05-06	07-07	08-08	09
06-07	08-08	09-09	10
07-08	09-09	10-10	11
08-09	10-10	11-11	12
09-10	11-11	12-12	13
10-11	12-12	13-13	14
11-12	13-13	14-14	15

BOARD 16 ORCH. SYMP. TONE GEN			
Lower	Upper	Divisor	Pin
Key	Key	Key	A
Hz	Hz	Hz	B
01-01	02-02	03-03	04
01-02	03-03	04-04	05
02-03	04-04	05-05	06
03-04	05-05	06-06	07
04-05	06-06	07-07	08
05-06	07-07	08-08	09
06-07	08-08	09-09	10
07-08	09-09	10-10	11
08-09	10-10	11-11	12
09-10	11-11	12-12	13
10-11	12-12	13-13	14
11-12	13-13	14-14	15



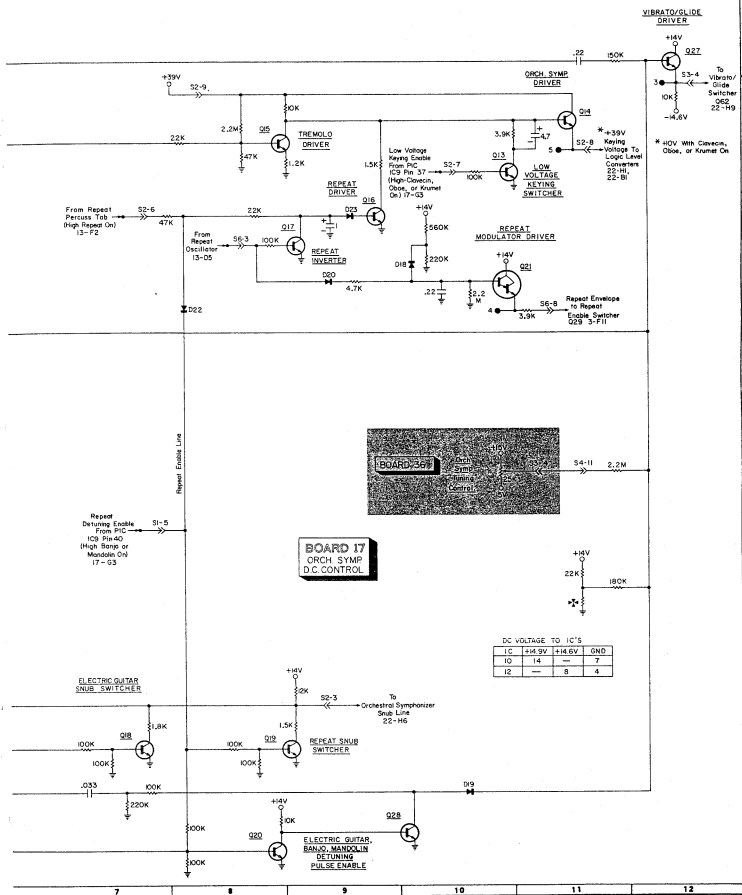
BOARD 16 ORCH. SYMP. TONE GEN

BOARD 16 ORCH. SYMP. TONE GEN			
Lower	Upper	Divisor	Pin
Key	Key	Key	A
Hz	Hz	Hz	B
01-01	02-02	03-03	04
01-02	03-03	04-04	05
02-03	04-04	05-05	06
03-04	05-05	06-06	07
04-05	06-06	07-07	08
05-06	07-07	08-08	09
06-07	08-08	09-09	10
07-08	09-09	10-10	11
08-09	10-10	11-11	12
09-10	11-11	12-12	13
10-11	12-12	13-13	14
11-12	13-13	14-14	15



ORCHESTRAL SYMPHONIZER DC CONTROL

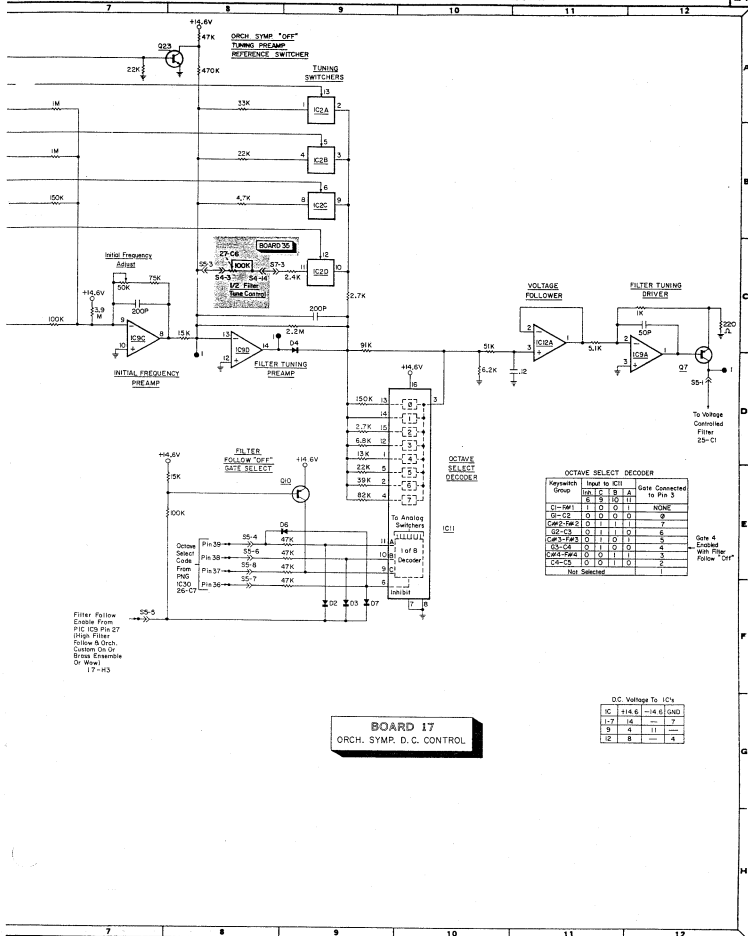
2



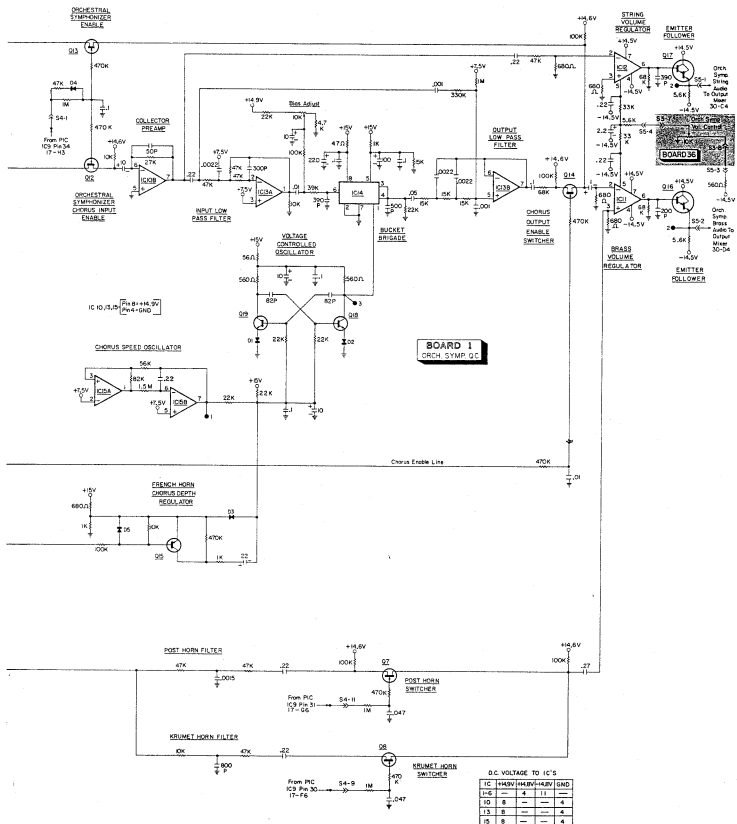


ORCHESTRAL SYMPHONIZER FILTER ENVELOPE

24







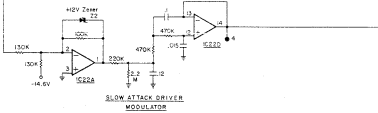








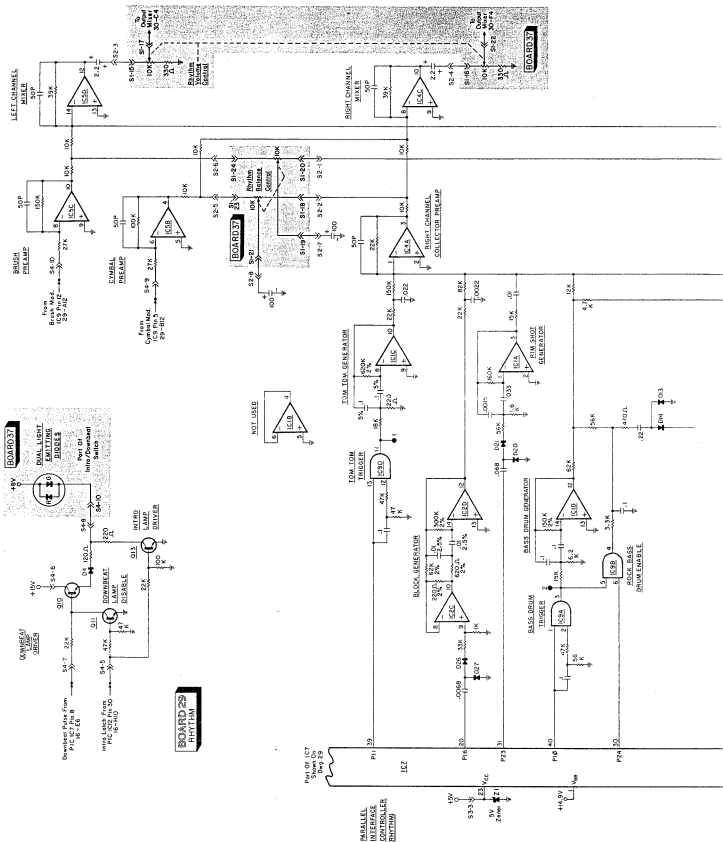




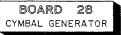
SLOW ATTACK DRIVER
MODULATOR





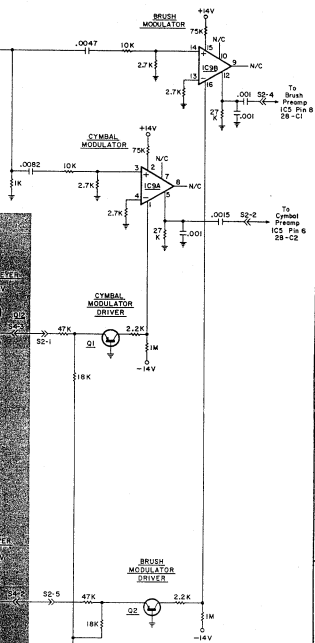
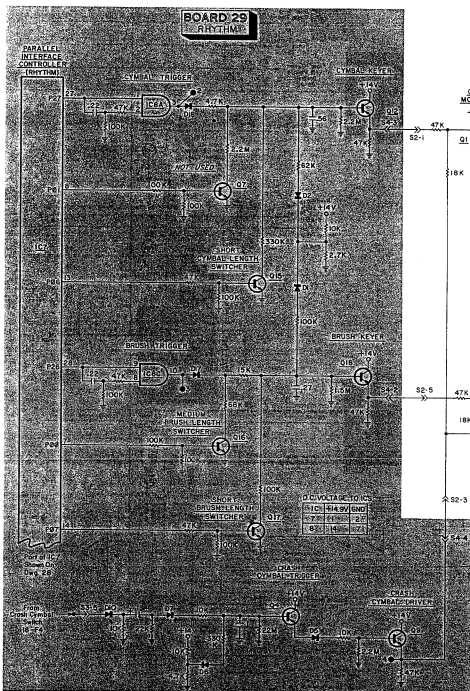






BRUSH CYMBAL GENERATOR

BOARD 28
CYMBAL GENERATOR



IC	+5V	+14V	-14V	GND
4J0	14	—	—	7
9	—	11	6	—

30



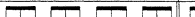
31







+24V FROM 32-D9
+15V FROM 32-B8
+9V FROM 32-C10
-15V FROM 32-D12

Ballad																									
		TIME POINT RHYTHM COUNT																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Instrumentation:	Snare				●						●						●						●		
	Brush	●	●	●		●	●	●		●	●	●	●	●	●	●		●	●	●		●	●	●	●
	Brush Snub				●	●	●	●		●	●	●	●				●	●	●		●	●	●	●	●
	Bass Drum	●						●		●						●				●					
Lower Keyboard	Chord	●			●			●			●			●			●						●		
	*Accent										●												●		
	Chord Sustain	●						●								●				●					
Genie Bass	5th							●												●					
	Root	●				●								●				●							

Tango																																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
TIME POINT RHYTHM COUNT		1	e	a	a	2	e	a	a	3	e	a	a	4	e	a	a	4	e	a	a	2	e	a	a	3	e	a	a	4	e	a	a	
Instrumentation	Snare	●				●				●				●		●	●	●	●	●	●	●					●				●	●	●	
	Cymbal																																	
	Bass Drum	●				●				●				●		●		●		●		●		●		●		●		●		●		●
Lower Keyboard	Chord	●				●				●				●		●		●		●		●		●		●		●		●		●		●
	* Accent																																	
	Chord Sustain																																	
Genie Bass	5th									●				●												●								
	Root	●				●																	●					●						

[illegible]

RHYTHM PATTERN CHARTS

Dixie

TIME POINT
RHYTHM COUNT

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		1	B	a	2	B	a	3	B	a	4	B	a	1	B	a	2	B	a	3	B	a	4	B	a
Instrumentation	Snare																								
	Cymbal	•																							
	Short Cymbal																								
	Brush																								
	Med. Brush																								
	Bass Drum	•												•											
Lower Keyboard	Chord	•											•												
	* Accent																								
	Chord Sustain	•																							
Genie Bass	5th																								
	Root	•											•												

Samba

TIME POINT
RHYTHM COUNT

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
		1	e	B	a	2	e	B	a	3	e	B	a	4	e	B	a	1	e	B	a	2	e	B	a	3	e	B	a	4	e	B	a
Instrumentation	High Drum																																
	Low Drum																																
	Tom Tom																																
	Bongo	•																															
	Snare	•																•															
	Cymbal	•																•															
	Brush	•																•															
	Med. Brush	•																•															
	Rock Bass Drum	•																•															
Lower Keyboard	Chord	•															•																
	* Accent	•															•																
	Chord Sustain	•															•																
Genie Bass	5th																																
	Root	•															•																

March $\frac{6}{8}$

TIME POINT
RHYTHM COUNT

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Instrumentation	Snare	•						•						•						•						•																							
	Cymbal	•						•						•						•						•																							
	Bass Drum	•						•						•						•						•																							
Lower Keyboard	Chord	•						•						•						•						•																							
	* Accent	•						•						•						•						•																							
	Chord Sustain	•						•						•						•						•																							
Genie Bass	5th							•						•						•						•																							
	Root	•						•						•						•						•																							

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 7-E11.

RHYTHM PATTERN CHARTS

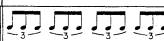
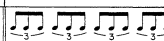
Swing		TIME POINT RHYTHM COUNT																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Instrumentation	High Drum																								
	Rim Shot																								
	Cymbal																								
	Short Cymbal																								
	Bass Drum																								
Lower Keyboard	Chord																								
	*Accent																								
	Chord Sustain																								
Genie Bass	5th																								
	Root																								

Bosa Nova																																	
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
RHYTHM COUNT		1	e	a	3	2	e	a	3	e	a	a	4	e	a	3	2	1	e	a	a	2	e	a	3	e	a	4	e	a	3	2	
Instrumentation	Block	●						●						●									●						●				
	High Drum	●																					●										
	Cymbal							●																	●							●	
	Short Cymbal							●																	●							●	
	Brush	●			●					●		●		●		●			●		●		●		●		●		●		●		
	Med. Brush					●								●		●							●		●		●			●		●	
	Bass Drum	●						●		●									●					●		●		●			●		
Lower Keyboard	Chord	●				●						●				●					●			●				●		●			
	*Accent					●										●							●					●					
	Chord Sustain	●								●														●				●					
Genie Bass	5th										●																●						
	Root	●						●											●					●									

Soft Rock																																		
TIME POINT RHYTHM COUNT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
		1	e	a	q	2	e	a	q	3	e	a	q	4	e	a	q	1	e	a	q	2	e	a	q	3	e	a	q	4	e	a	q	
Instrumentation	Snare																																	
	Cymbal																																	
	Brush	•		•		•		•		•		•		•		•		•		•		•		•		•		•		•		•		•
	Med. Brush	•		•		•		•		•		•		•		•		•		•		•		•		•		•		•		•		•
	Rock Bass Drum																																	
Lower Keyboard	Chord	•				•				•				•				•				•				•				•				•
	*Accent																																	
	Chord Sustain	•				•				•				•				•				•				•				•				•
Genie Bass	5th									•																								
	Root	•				•				•				•				•				•				•				•				•

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 7-E11.

RHYTHM PATTERN CHARTS

Country																																	
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
RHYTHM COUNT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Instrumentation	High Drum																																
	Low Drum																																
	Snare																																
	Brush																																
	Med. Brush																																
	Short Brush																																
Lower Keyboard	Bass Drum																																
	*Chord																																
	*Accent																																
Genie Bass	Chord Sustain																																
	5th																																
	Root																																

Rhumba																																	
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
RHYTHM COUNT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Instrumentation	Clave																																
	High Drum																																
	Low Drum																																
	Bongo																																
	Tom Tom																																
	Brush																																
Lower Keyboard	Med. Brush																																
	Bass Drum																																
	Chord																																
Genie Bass	*Accent																																
	Chord Sustain																																
Genie Bass	5th																																
	Root																																

Disco																																	
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
RHYTHM COUNT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Instrumentation	High Drum																																
	Low Drum																																
	Bongo																																
	Snare																																
	Cymbal																																
	Short Cymbal																																
Lower Keyboard	Brush																																
	Short Brush																																
	Rock Bass Drum																																
Genie Bass	Chord																																
	*Accent																																
Genie Bass	Chord Sustain																																
	5th																																
Genie Bass	Root																																

*Accent refers to Lower Keyboard Accent Circuit located on Drawing 7-E11.

RHYTHM PATTERN CHARTS

Swing Waltz																			
		TIME POINT RHYTHM COUNT																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		1	a	a	2	a	a	3	a	a	1	a	a	2	a	a	3	a	a
Instrumentation	Snare																		
	Cymbal	●			●			●			●			●			●		
	Short Cymbal																		
	Bass Drum	●				●					●			●					
Lower Keyboard	Chord				●			●					●		●			●	
	*Accent					●				●								●	
	Chord Sustain							●						●					
Genie Bass	5th																●		
	Root	●						●											

Cha Cha																																		
		TIME POINT RHYTHM COUNT																																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
		1	e	a	2	e	a	3	e	a	4	e	a	1	e	a	2	e	a	3	e	a	4	e	a	1	e	a	2	e	a	3	e	a
Instrumentation	Clave																																	
	Block																																	
	High Drum																																	
	Low Drum																																	
	Bongo																																	
	Tom Tom																																	
	Brush																																	
	Med. Brush																																	
	Bass Drum																																	
Lower Keyboard	Chord																																	
	*Accent																																	
	Chord Sustain																																	
Genie Bass	5th																																	
	Root																																	

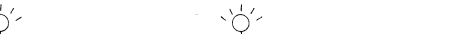
Polka																																			
		TIME POINT RHYTHM COUNT																																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32		
		1	e	a	2	e	a	3	e	a	4	e	a	1	e	a	2	e	a	3	e	a	4	e	a	1	e	a	2	e	a	3	e	a	
Instrumentation	Snare	●				●								●					●								●						●	●	●
	Brush	●																																	
	Bass Drum	●									●								●																
Lower Keyboard	Chord	●								●				●				●								●							●		●
	*Accent					●								●											●								●		●
	Chord Sustain	●																																	
Genie Bass	5th																																		
	Root	●																																	

*Accent refers to Lower Keyboard Accent Circuit located on Drawing 7-E11.

RHYTHM PATTERN CHARTS

Waltz																			
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RHYTHM COUNT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Instrumentation	Snare																		
	Cymbal																		
	Bass Drum																		
Lower Keyboard	Chord																		
	* Accent																		
	Chord Sustain																		
Genie Bass	5th																		
	Root																		

Latin Rock																																	
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
RHYTHM COUNT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Instrumentation	Clave	●				●				●				●				●				●				●				●			
	Block	●																●							●				●				
	High Drum			●		●				●		●		●				●			●		●				●			●			
	Low Drum						●						●			●						●		●				●			●		
	Snare					●								●								●				●				●			
	Bongo					●									●								●						●				
	Tom Tom																						●						●		●		
	Brush	●		●		●		●		●		●		●		●		●		●		●		●		●		●		●		●	
	Med. Brush					●		●						●		●						●		●			●			●		●	
Bass Drum	●									●				●				●							●			●		●			
Lower Keyboard	Chord	●				●				●		●		●			●	●				●		●		●		●				●	
	*Accent											●																●					
	Chord Sustain	●				●						●						●				●				●		●					
Genie Bass	5th									●				●													●			●			
	Root	●																●															

Metronome																																	
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
RHYTHM COUNT		1	e	8	a	2	e	8	a	3	e	8	a	4	e	8	a	1	e	8	a	2	e	8	a	3	e	8	a	4	e	8	a
Instrumentation	Clave																																
	Block	●					●				●				●			●				●				●				●			
Lower Keyboard	Chord						●							●								●								●			
	* Accent																															●	
	Chord Sustain						●							●								●								●			
Genie Bass	5th										●																						
	Root	●																●								●							

* Accent refers to Lower Keyboard Accent Circuit located on Drawing 7-E11.

RHYTHM PATTERN CHARTS

Intro I

TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
RHYTHM COUNT		1	e	8	a	2	e	8	a	3	e	8	a	4	e	8	a	1	e	8	a	2	e	8	a	3	e	8	a	4	e	8	a
Instrumentation	High Drum	•																•															
	Snare	•						•		•								•		•						•			•	•	•		
	Bongo	•									•																		•				
	Tom Tom																													•		•	
	Cymbal	•									•																						
	Bass Drum																																•

Used for Ballad, Dixie, Swing, Country & March Rhythms.

Intro II

TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RHYTHM COUNT		1	8	a	2	8	a	3	8	a	4	8	a	1	8	a	2	8	a	3	8	a	4	8	a
Instrumentation	Snare			•	•		•			•	•	•	•		•	•	•	•	•	•			•	•	•
	Low Drum																								
	Bongo																								
	Tom Tom																								
	Cymbal	•								•													•	•	•
	Short Cymbal																								
	Bass Drum	•								•					•							•	•	•	•

Used for Swing Waltz & Waltz Rhythms.

Intro III

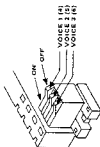
TIME POINT		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RHYTHM COUNT		1	e	8	a	2	e	8	a	1	e	8	a	2	e	8	a
Instrumentation	Snare	•	•	•	•		•	•	•	•		•			•	•	•
	Cymbal	•										•					•
	Bass Drum	•								•							•

Used for Tango, Samba, Bossa Nova, Rhumba, Cha Cha, Latin Rock, Rock, Soft Rock, Disco, Polka & Metronome Rhythms.

*Accent refers to Lower Keyboard Accent Circuit located on Drawing 7-E11.

ORCHESTRATION PLUS VOICE CHANNEL CHART

NOTE: To check On/Off status, refer "C" key on Lower Keyboard. Shut off three position DIP Switches located on Board 20A and 20B. Your channel name is as shown. See Chart below.



ORCH. PLUS STYLE	VOICE CHANNEL	NORMAL	VARIATION	MODE	VARIATION	BASIC
BIG BAND	1	Brass Sax	Brass Pattern	Brass Sax	No Change	No Change
	2	Brass Sax	Brass Pattern	Brass Sax	No Change	No Change
	3	Brass Sax	Brass Pattern	Brass Sax	No Change	No Change
	4	Brass Sax	Brass Pattern	Brass Sax	No Change	No Change
	5	Brass Sax	Brass Pattern	Brass Sax	No Change	No Change
	6	String Bass	No Change	Electric Bass	No Change	No Change
CONTEMPO	1	Electric Guitar	Electric Guitar with Chorus	Electric Guitar	No Change	No Change
	2	Electric Guitar	Electric Guitar with Chorus	Electric Guitar	No Change	No Change
	3	Electric Guitar	Electric Guitar with Chorus	Electric Guitar	No Change	No Change
	4	Cello	No Change	No Change	No Change	No Change
	5	None	Electric Bass *	None	No Change	No Change
	6	Electric Bass	None	None	No Change	No Change
POLKA**	1	Clarinet	No Change	No Change	No Change	No Change
	2	Trumpet	No Change	Trumpet	No Change	No Change
	3	Trumpet	No Change	Trumpet	No Change	No Change
	4	Brass	No Change	Brass	No Change	No Change
	5	Brass	No Change	Brass	No Change	No Change
	6	Tuba	No Change	None	No Change	No Change
COUNTRY	1	Steel Guitar	None	None	No Change	No Change
	2	Steel Guitar	None	None	No Change	No Change
	3	Acoustic Guitar	None	None	No Change	No Change
	4	Acoustic Guitar	None	None	No Change	No Change
	5	Acoustic Guitar	None	None	No Change	No Change
	6	String Bass	No Change	None	No Change	No Change
JAZZ GUITAR	1	Electric Guitar	No Change	Electric Guitar	No Change	No Change
	2	Electric Guitar	No Change	None	No Change	No Change
	3	Electric Guitar	No Change	None	No Change	No Change
	4	Electric Guitar	No Change	None	No Change	No Change
	5	None	String Bass*	None	No Change	No Change
	6	String Bass	None	None	No Change	No Change
ROCK	1	Electric Guitar	Synthesized	Electric Guitar	No Change	No Change
	2	Electric Guitar	Synthesized	Electric Guitar	No Change	No Change
	3	Electric Guitar	Synthesized	Electric Guitar	No Change	No Change
	4	Electric Guitar	Synthesized	Electric Guitar	No Change	No Change
	5	None	None	None	No Change	No Change
	6	Electric Bass	No Change	None	No Change	No Change

*When working on Variations with the Compressor, Amp, Guitar, Rhythm Guitar or Waltz styles, the Bass Pattern changes and the Bass Audio is produced by Voice Channel 5 instead of Channel 6.

**The Moeris Accordion Voice plays in Voice Channels 1 & 2 if the C chord is memorized. Turning on voice 1 will change the voice.

NONE = Channel not used at this time.

NORMAL MODE = On/Off plus on/off without Variation or Basic Mode.

NO CHANGE = No change from Normal Mode of operation.

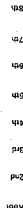
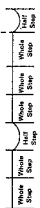
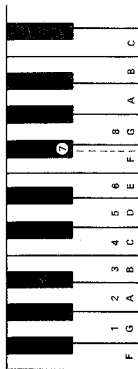
ORCHESTRATION PLUS STYLE DESCRIPTION CHART

STYLE	NORMAL	VARIATION	MINOR (BASIC) MODE
<u>BIG BAND</u> NORMALLY 4/4 CAN PLAY 3/4	- BRASS SECTION - SAX SECTION - 4 BEAT STRING BASS - BRASS SECTION FIGURES ALTERNATE WITH SAX SECTION FIGURES	- BRASS FIGURES ONLY	- BRASS SECTION PLAYS BRASS FIGURES ALTERNATING WITH BRASS SECTION PLAYING SAX FIGURES
<u>CONTEMPORARY</u> NORMALLY 4/4 CAN PLAY 3/4	- ARPEGGIATED ELECTRIC GUITAR - CELLO - ELECTRIC BASS	- "PHASING" SOUND IS ADDED TO ELECTRIC GUITAR - BASS FIGURES BECOME MORE ACTIVE	- NO EFFECT
<u>POLKA</u> 4/4 - WILL NOT PLAY 3/4	- BRASS SECTION - CLARINETS - MUSETTE ACCORDION - TUBA	- SILENCES MUSETTE ACCORDION	- BRASS SECTION ONLY
<u>COUNTRY</u> 4/4 - WILL NOT PLAY 3/4	- STEEL GUITAR - PIANO - ACOUSTIC RHYTHM GUITAR - STRING BASS	- RHYTHM GUITAR AND STRING BASS ONLY	- NO EFFECT
<u>JAZZ GUITAR</u> NORMALLY 4/4 CAN PLAY 3/4	- ELECTRIC GUITAR PLAYS "JAZZ" TYPE ACCOMPANIMENT - 4 BEAT STRING BASS	- BASS CHANGES TO 2 BEAT	- CHANGES CHORDS TO BASIC CHORDS
<u>ROCK</u> NORMALLY 4/4 CAN PLAY 3/4	- ELECTRIC GUITAR - ELECTRIC BASS	- ADDS SYNTHESIZER SOUNDS TO ELECTRIC GUITAR	- NO EFFECT

ORCHESTRATION PLUS STYLE DESCRIPTION CHART

STYLE	NORMAL	VARIATION	MINOR (BASIC) MODE
<u>BAROQUE</u> NORMALLY 4/4 CAN PLAY 3/4	- HARPSICHORD - ELECTRIC BASS	- HARPSICHORD ONLY (NO BASS)	- NO EFFECT
<u>BLUEGRASS</u> 4/4 - WILL NOT PLAY 3/4	- 5 STRING BANJO - ACOUSTIC RHYTHM GUITAR - STRING BASS	- ADDS "HOEDOWN" FIDDLE	- NO EFFECT
<u>RHYTHM GUITAR</u> NORMALLY 4/4 CAN PLAY 3/4	- ACOUSTIC GUITAR PLAYS STRAIGHT RHYTHM - 4 BEAT STRING BASS	- BASS CHANGES TO 2 BEAT	- CHANGES CHORD TO BASIC CHORDS
<u>DISCO</u> NORMALLY 4/4 CAN PLAY 3/4	- CLAVINET - ELECTRIC BASS	- ADDS BRASS SECTION	- NO EFFECT
<u>WALTZ</u> NORMALLY 3/4 CAN PLAY 4/4	- FULL STRING SECTION - STRING BASS	- STRING SECTION CHANGES TO ACOUSTIC GUITAR PLAY- ING STRAIGHT RHYTHM	- CHANGES CHORDS TO BASIC CHORDS
<u>LATIN</u> NORMALLY 4/4 CAN PLAY 3/4	- ELECTRIC GUITAR PLAYS BOSSA NOVA FIGURES - STRING BASS	- ELECTRIC GUITAR CHANGES TO ACOUSTIC GUITAR	- SEE ABOVE

SCALE AND CHORD STRUCTURE



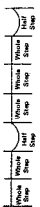
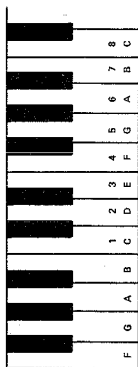
KEY SIGNATURE (ALL F'S RAISED ONE HALF STEP - G SCALE)

NOTE	INTER-VAL	1st Root	2nd	3rd	4th	5th	6th	7th	8th Octave
G	Whole Step	A	B	C	D	E	F#	G	

EXAMPLE OF G MAJOR SCALE

CHORD STRUCTURE - To make chords on any scale

CHORD NAME	STRUCTURE (STANDARD)	PLAYED ON MX1
MAJOR	Root 3rd 5th	Root
MINOR	Root 3rd Lowered One Half Step 5th	Root 3rd Lowered One Half Step
DIMINISHED	Root 3rd Lowered One Half Step 5th Lowered One Half Step	Root 5th Lowered One Half Step
AUGMENTED	Root 3rd 5th Raised One Half Step	Root 3rd 5th Raised One Half Step
7TH	Root 3rd 5th 7th Lowered One Half Step	Root 7th Lowered One Half Step (2 keys to left of Root)



NOTE	INTER-VAL	1st Root	2nd	3rd	4th	5th	6th	7th	8th Octave
C	Whole Step	D	E	F	G	A	B	C	

EXAMPLE OF C MAJOR SCALE

MAJOR SCALES - The following procedure will construct any Major Scale.

- NOTE: All keys (Black and White) must be counted.
1. The Root or First note of any scale is the key from which the scale is named. (i.e., C scale = C key or G scale = G key).
 2. Count 2 physical keys (whole step) to right to arrive at 2nd - then -
 3. Count 2 physical keys (whole step) to right to arrive at 3rd - then -
 4. Count 1 physical key (half step) to right to arrive at 4th - then -
 5. Count 2 physical keys (whole step) to right to arrive at 5th - then -
 6. Count 2 physical keys (whole step) to right to arrive at 6th - then -
 7. Count 2 physical keys (whole step) to right to arrive at 7th - then -
 8. Count 1 physical key (half step) to right to arrive at 8th or octave.

CHECKOUT PROCEDURE FOR A.O.C. OPEN HARMONY

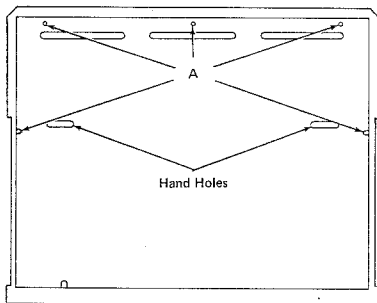
1. Turn on A.O.C. Organ and A.O.C. Open Harmony tabswitches.
2. Turn off all Lower Keyboard tabswitches.
3. Turn off all Upper Keyboard tabswitches except Flute 8' tabswitch.
4. Hold C2 on Lower Keyboard for remainder of test.
5. Play C2 through C5 on Upper Keyboard.

Chart below indicates coupling which takes place.

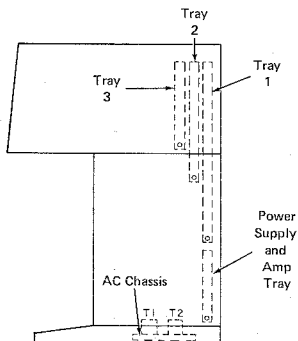
NOTES PLAYED		COUPLED NOTE	TWO NOTES HEARD
Lower	Upper		
C2 ↓	C2	None	C2 Only
	C#2	C1	C1 — C#2
	D2	C1	C1 — D2
	D#2	C1	C1 — D#
	E2	C1	C1 — E2
	F2	C1	C1 — F2
	F#2	C2	C2 — F#2
	G2	C2	C2 — G2
	G#2	C2	C2 — G#2
	A2	C2	C2 — A2
	A#2	C2	C2 — A#2
	B2	C2	C2 — B2
	C3	None	C3 Only
	C#3	C2	C2 — C#3
	D3	C2	C2 — D3
	D#3	C2	C2 — D#
	E3	C2	C2 — E3
	F3	C2	C2 — F3
	F#3	C3	C3 — F#3
	G3	C3	C3 — G3
	G#3	C3	C3 — G#3
	A3	C3	C3 — A3
	A#3	C3	C3 — A#3
	B3	C3	C3 — B3
	C4	None	C4 Only
	C#4	C3	C3 — C#4
	D4	C3	C3 — D4
	D#4	C3	C3 — D#4
	E4	C3	C3 — E4
	F4	C3	C3 — F4
	F#4	C4	C4 — F#4
	G4	C4	C4 — G4
	G#	C4	C4 — G#4
	A4	C4	C4 — A4
	A#4	C4	C4 — A#4
	B4	C4	C4 — B4
	C5	None	C5 Only

TO REMOVE BACK

1. Remove five screws marked A.
2. Grip organ back through hand holes pulling out toward you.
3. Raise organ back out of bottom channel.

TO REPLACE BACK

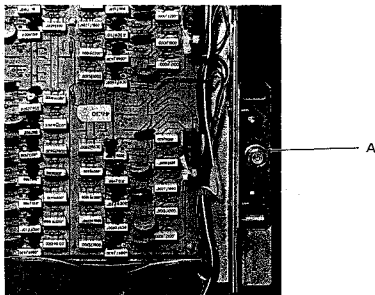
1. Raise organ back through hand holes and insert in bottom channel.
2. Push organ back into correct position and replace five screws marked A.



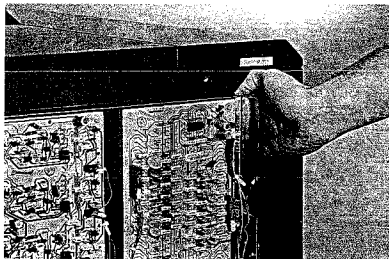
CIRCUIT BOARD TRAY ACCESS

TO LOWER TRAY 1

1. Remove bolt A (2) from left and right sides of tray. (Right side shown)



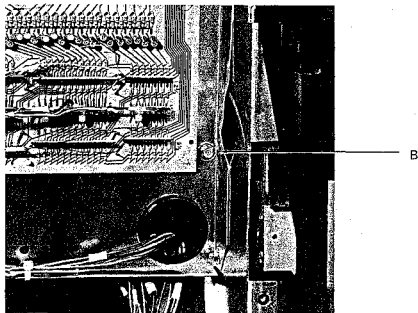
2. Placing hand as shown on top of tray, pull outward and lower into horizontal position held by straps.



CIRCUIT BOARD TRAY ACCESS

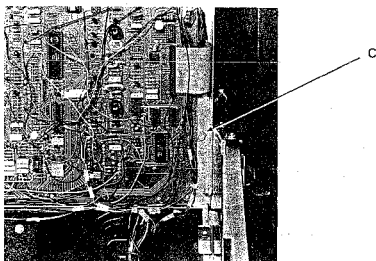
TO LOWER TRAY 2

1. Remove bolt B (2) from left and right sides of tray. (Right side shown)
2. Grasp tray edge at top, pulling outward and lower to horizontal position.



TO LOWER TRAY 3

1. Remove bolt C (2) from left and right sides of tray. (Right side shown)
2. Grasp tray edge at top pulling outward and lower to horizontal position.

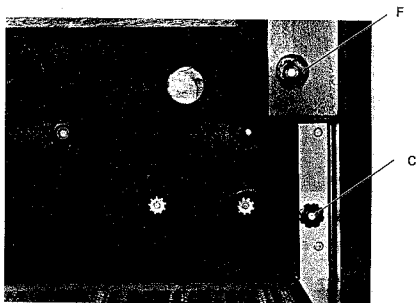


LOWER KEYSWITCH ACCESS

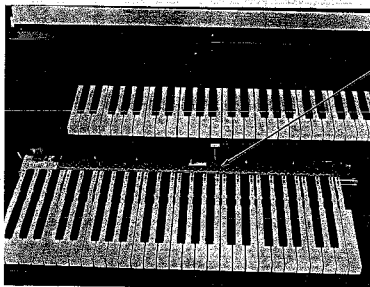
1. Remove Lowrey keyswitch rail by removing 6 Phillips screws.
2. Remove bolt C (2) located underneath keybed on left and right sides of organ. (Right side shown.)
3. Position spotlights at an angle closest to the side tab panels.
4. Lower all three circuit board trays. (See circuit board tray descriptions.) Lift and slide upper keybed toward rear of organ, being careful not to damage wiring harnesses.

Lower keyswitches are now accessible from front of organ as shown in bottom photo.

Lower Keybed
(from below,
right side)



Lower
Keyswitches



SIDE TAB PANEL ACCESS

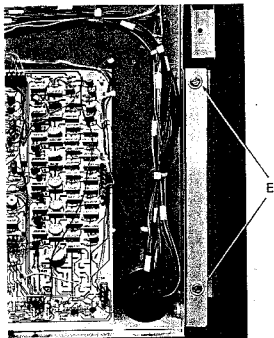


PHOTO 1

1. Remove screws E (2 each side) from both sides of tray assembly.
2. Lower Power Supply-Amplifier tray.
3. Unplug reverb unit (located above bass pedal assembly).
4. Perform Lower Keyswitch Access Procedure.
5. Remove bolt F (2). (See Lower Keyswitch Access Photo.)
6. Remove tie wraps on pedal cable (right side) and 6x9 speaker cable (left side) to gain access to side panels. Pedal light power board should be unplugged and removed from stand off. (See Photo 2.)

CAUTION: Slide trays back slowly and observe all cabling for stress.

7. Slide entire tray assembly out, first by pulling on trays 1 and 2, then by pulling on tray assembly bracket indicated in Photo 2.

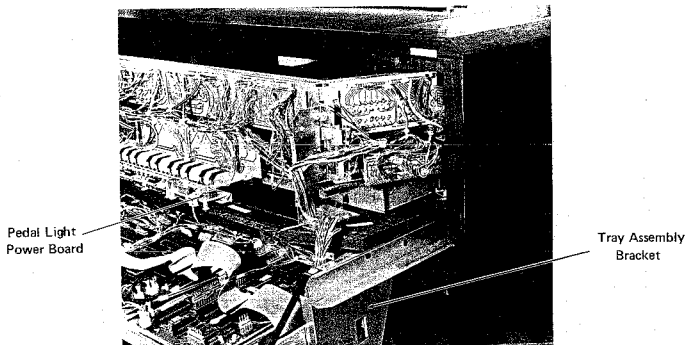
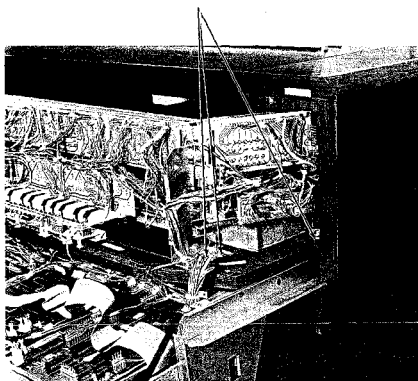


PHOTO 2

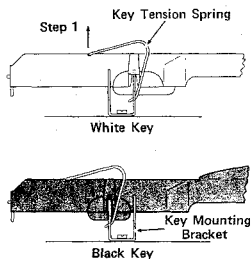
UPPER KEYS ACCESS

1. Perform steps listed in Side Tab Panel Access.
2. Remove three screws on each side of upper keybed.
3. Pull upper keybed toward front of organ, freeing it from tab panel, exposing upper keys for replacement.

Remove these screws



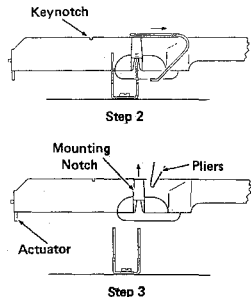
KEY REMOVAL AND REPLACEMENT/PEDAL LIGHT ACCESS



KEY REMOVAL

Note: See Lower Keyswitch Access and Upper Keys Access.

1. Using long nose pliers, lift key tension spring from notch in key.
2. Slide key tension spring toward front of key, removing its ends from holes in key mounting bracket.
3. Using long nose pliers, grip key directly in front of mounting notch and lift key from key mounting bracket. In some cases, to remove a white key the adjacent black key or keys must be removed first.



KEY REPLACEMENT

1. Push key downward onto key mounting bracket at mounting notch so that it fits snugly.
2. Place key tension spring over key forward of mounting notch.
3. Slide key tension spring toward rear so that it snaps into key notch making sure its ends fit into holes in key mounting bracket.
4. Verify that keyswitch contact is within actuator.

PEDAL LIGHT REMOVAL

1. Remove the Lower Keys C1, C#1, and D1. (See Key Removal.)
2. Grasp light assembly, turn counterclockwise and pull out.
3. Pull bulb out of socket.

PEDAL LIGHT REPLACEMENT

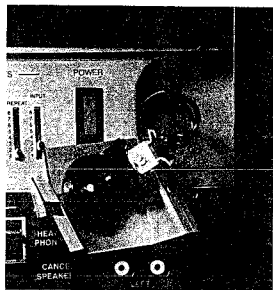
1. Push bulb securely into socket.
2. Push light assembly into slot, turn clockwise until securely locked.
3. Replace keys. (See Key Replacement.)

SPOT LIGHT BULB REPLACEMENT



Remove these
screws

1. Remove top and bottom screws.
2. Pull socket from spot light housing.
3. Remove bulb from socket, replace with new bulb.
4. Push socket into spot light housing.
5. Replace housing with screws (light screw top, dark screw bottom).



TAB PANEL DISASSEMBLY

1. Put all tabs into off position.
2. Remove the five screws.
3. Carefully separate tabswitch assembly from front panel, rotating bottom of assembly toward rear of organ.

FIG. 1
Tab Panel (Rear View)

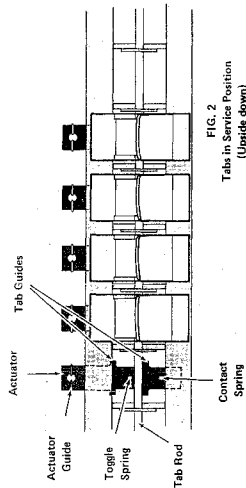
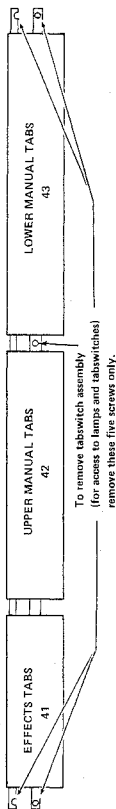


FIG. 2
Tabs in Service Position
(Upside down)

TAB REMOVAL

1. Carefully separate tabswitch assembly from front panel, rotating bottom of assembly toward rear of organ. (See Tab Panel Disassembly Fig. 1)
2. To remove tab push down firmly, releasing it from tab rod.

TAB REPLACEMENT

1. Insert tab so actuator fits between rear slot of tab and tab is positioned between tab guides on actuator.
2. Push tab forward until tab rod is positioned as shown by dotted circle in Fig. 3.
3. Push firmly upward on tab until tab rod locks into position, as shown by solid circle in Fig. 3.

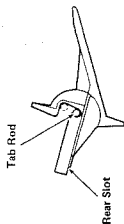


FIG. 3
Side View of Upside Down Tab

CAUTION: Do not remove
PC Board mounting screws.

PUSHBUTTON SWITCH ACCESS

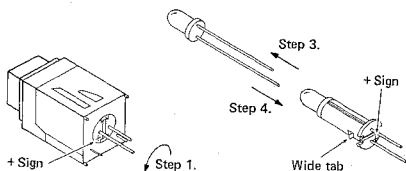
Pushbutton Switch Boards are located directly above tabswitch boards, accessible from rear of tab panels. To dismantle pushbutton boards:

1. Disconnect the plugs from the sockets of the board to be accessed.
NOTE: Observe the position and direction of each connector to reduce the possibility of miswiring the board upon reassembly.
2. Remove knobs from any potentiometers mounted to board being accessed.
3. Remove the mounting screws from the board.
4. Remove board from organ.
5. Unsolder potentiometer or pushbutton switch to be serviced.

To install the pushbutton board:

1. Mount board in organ and secure with the mounting screws.
2. Reconnect the plugs and insert knobs on potentiometers.
3. Test each switch and potentiometer for proper operation.

PUSHBUTTON SWITCH BULB REPLACEMENT



1. Using small screwdriver, rotate socket 1/4 turn counter-clockwise.
2. Remove bulb and socket by pulling bulb leads outward.
3. Remove bulb from socket.
4. Insert replacement bulb into socket, inserting the long bulb lead through the opening at bottom of socket indicated by the + sign.
5. Insert bulb and socket into housing, keeping wide tab of socket on left. Rotate socket 1/4 turn clockwise.
6. After socket replacement, pull on bulb leads to insure proper seating of bulb on top of socket. Improper seating can cause an inoperative switch.

PARTS INFORMATION

PARTS ORDERING PROCEDURE

Call: (800) 323-3532. In Illinois dial 312-759-5104.

The toll-free number is available 24 hours a day, 7 days a week. During working hours, it is answered by Parts Department personnel.

or

Write: LOWREY SERVICE PARTS DEPARTMENT

1300 Naperville Drive
Romeoville, IL 60441

In Canada, Call: (416) 752-6355

or

Write: LOWREY ORGAN COMPANY, LTD.,

SERVICE DEPARTMENT
124 Milner Avenue
Agincourt, Ontario, Canada M1S 9Z9

Be sure to include the following information:

1. Your name and address
2. Your account number
3. Shipping preference
4. Complete Part Number
5. A brief description of the part

If you wish to have the parts billed to one address and shipped to another, it is necessary to have the full name, address and account number of the store being billed.

If unknown and not in the service manual, provide a complete description of the part.

AVOID DELAYS BY USING COMPLETE PART NUMBERS

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PARTS LIST

BOARD 1

Orchestral Symphonizer QC

Integrated Circuits

IC1-6	LM348	991-025267-000
IC7, 8	LM13600N	991-029876-000
IC9	CD4016BE	991-028679-001
IC10, 13, 15	MC1458C	991-025244-000
IC11, 12	CA3080E	991-021444-002
IC14	SAD-512D	991-028690-000

Transistors

Q1	991-002232-000
Q2-14	991-028269-000
Q15	991-010098-000
Q16, 17	991-026617-000
Q18, 19	991-028691-000

BOARD 2

Solo Filter

Integrated Circuits

IC16-20	CD4016BE	991-028679-001
IC25	MC1458C	991-025244-000
IC26-28	LM13600N	991-029876-000

Transistors

Q25, 27-31, 33, 35, 37, 40	991-018238-000
Q26	991-028269-000
Q32, 34, 36, 38	991-010098-000
Q39	991-016727-000

BOARD 3

Main Quality Control

Integrated Circuits

IC1, 2	CA3080E	991-021444-002
IC3, 4	LM348	991-025267-000

Transistors

Q1-4, 6, 7, 9, 11, 13, 15-21, 26, 28, 29, 31, 36-38	991-028269-000
Q5, 10, 12, 27, 30, 32-35	991-018238-000
Q8, 14, 22, 23	991-026617-000
Q24, 25	991-010098-000

BOARD 4

Three Channel Chorus

Integrated Circuits

IC1	CD4069VB	991-027359-002
IC2-4	LM348	991-025267-000
IC5, 6	CD4027BE	991-026022-001
IC7-9	SAD-512D	991-028690-000

BOARD 4 (Continued)

Transistors

Q2-4	991-016727-000
Q5, 6, 9, 10, 13, 14	991-028691-000
Q7, 8, 11, 12, 15, 16	991-026315-000

BOARD 5

Two Channel Chorus

Integrated Circuits

IC1, 2, 5	MC1458C	991-025244-000
IC3, 4	SAD-512D	991-028690-000

Transistors

Q1, 2	991-016727-000
Q3-6	991-028691-000
Q7-10	991-026315-002

BOARD 6

Upper Fractional Flute Filter

Integrated Circuits

IC1	RC4136	991-022794-000
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Transistors

All	991-030752-000
-----	----------------

BOARD 7

Lower Sustain Flute Filter

Integrated Circuits

IC1, 2	RC4136	991-022794-000
IC3	MC1458C	991-025244-000
IC4, 5	CA3080E	991-021444-001

Transistors

Q2-8, 11-17, 21-34, 38-44	991-030752-000
Q46-48, 51-56	991-028269-000
Q50	991-026617-000

BOARD 8

Hawaiian Guitar

Integrated Circuits

IC1	CD4016BE	991-028679-001
IC2	CA3080E	991-021444-001
IC3	MC1458C	991-025244-000
IC4	SAD-512D	991-028690-000

Transistors

Q1, 2	991-028691-000
Q3, 4, 6	991-026315-000
Q5, 8	991-016727-000
Q7	991-030753-000

PARTS LIST

BOARD 9

Mixer

Integrated Circuits

IC1-5, 8	CA3080E	991-021444-001
IC6, 7	RC4136	991-022794-000
IC9	MC1458C	991-025244-000

Transistors

Q1, 8, 9, 11	991-026315-002
Q2-7, 19-23	991-028269-000
Q10	991-016727-000
Q12-17	991-026617-000
Q18	991-010098-000

BOARD 10

Upper Sustain Flute Filter

Integrated Circuits

IC1-4	RC4136	991-022794-000
IC5	CA3080E	991-021444-002

Photocells

P1, 2	948-022782-000
-------	----------------

Transistors

Q1-3, 6-14, 26, 46, 48, 49	991-028269-000
Q4	991-016727-000
Q5, 17-23, 28-34, 37-43	991-030752-000
Q15, 27, 47, 50	991-010098-000
Q16	991-026315-002

BOARD 12

Solo Keyer

Coil

L1	Oscillator	952-018874-007
----	------------	----------------

Diodes

D10-12, 16-19, 44, 47, 48 . . .	919-004799-050
Z1 Zener 3.9V 1/2W	919-026799-151
Z2 Zener 12V 1/2W	919-026799-165
All others	919-024769-050

Integrated Circuits

IC1-4	CD4069VB	991-027359-002
IC5-13	CD4016BE	991-028679-001
IC21	CD4001UB	991-026025-002
IC22, 23	LM348	991-025267-000
IC24	MC1458C	991-025244-000
IC29	LM311	991-028688-000
IC30	EA5068	920-025507-000
IC31	CD4061BE	991-025517-000
IC32	CD4024BE	991-028681-001

BOARD 12 (Continued)

Transistors

Q1-3, 8, 11, 12, 16, 18, 19, 21, 25, 26	991-026315-000
Q4, 14, 15, 22, 24	991-010098-000
Q5-7, 9, 10, 17	991-016727-000
Q13	991-018238-001
Q20	991-013599-000
Q23	991-031685-000

BOARDS 13 & 14

Orchestral Symphonizer Keyers

Diodes

D2, 3, 6, 7	919-004799-050
All others	919-024769-050

Integrated Circuits

IC1	EA5070	991-022793-000
IC2-5	UDN-2982A	991-029873-000

Network

18-Pin, 68K	949-027483-000
-------------	----------------

Transistors

Q1-34	991-026617-000
Q35	991-030753-000

BOARD 15

Keyboard Encoder

Integrated Circuits

IC1, 2	DM7407N	991-029852-000
IC3, 9, 29	CD4001BC	991-026025-001
IC4	CD4050BE	991-028650-001
IC5 35	CD4069UBE	991-027359-002
IC6, 21, 24, 33, 34	CD4006AE	991-026603-000
IC7, 12, 25, 32	MC14174B	991-028685-001
IC8, 16-18, 38	CD4031AE	991-026603-000

PARTS LIST

BOARD 15 (Continued)

Integrated Circuits

IC10, 13, 19, 36		
CD4071BE	....	991-025516-000
IC11, 20, 23		
CD4013BE	....	991-027358-001
IC14, 30	CD4086BE	 991-026614-000
IC15, 22, 26, 28		
CD4081BE	....	991-025517-000
IC27, 31	CD4085BE	 991-026613-000
IC37	CD4073AE	 991-028684-001
IC39-41	MC14021B	 991-029866-000

Transistors	All	 991-026315-000
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BOARD 16

Orch. Symp. Tone Generator

Coil

L1	Oscillator	 952-018874-007
----	------------	---------------------

Integrated Circuits

IC1, 3-14	CD4024BE	 991-028681-001
IC2	MK50240N	 991-027326-000

Transistors

Q1-54, 62	....	991-026315-000
Q63	....	991-018238-001

BOARD 17

Orch. Symp. DC Control

Integrated Circuits

IC1-6	CD4016BE	 991-028679-001
IC7	CD4001UBE	 991-026025-002
IC9	LM348	 991-025267-000
IC10	CD4011UBE	 991-025515-002
IC11	CD4051BE	 991-029868-001
IC12	LM358	 991-029888-000

Transistors

Q1, 4, 12, 17-20, 24-26,		
28, 30, 32-34	....	991-026315-000
Q2, 3, 11, 13, 15, 16	....	991-013544-000
Q5, 8, 31	....	991-010098-000
Q6, 21	....	991-016727-000
Q7	....	991-013599-000
Q10	....	991-030753-000
Q14	....	991-020425-001
Q22	....	991-010098-004
Q23, 27	....	991-026315-002

BOARD 18

Main DC Control

Diodes

Z1	Zener 10V 5W	 919-017406-057
All others	....	919-024769-050

BOARD 18 (Continued)

Integrated Circuits

IC1	CD4001UBE	 991-026025-002
-----	-----------	---------------------

Transistors

Q1, 4, 9, 10, 13, 16-20, 22-29,		
32, 35, 37	....	991-026315-000
Q2, 21, 34	....	991-016727-000
Q3	....	991-013544-000
Q8, 11, 30	....	991-010098-000
Q12	....	991-020425-001
Q14, 15	....	991-026617-000

BOARD 19

Pedal Keyer & Filter

Integrated Circuits

IC1-3	CD4021B	 991-029866-000
IC4	LM348	 991-025267-000
IC5	CD4013BE	 991-027358-001

Transistors

Q1, 2, 6, 10, 12, 14, 20, 24-26,		
Q3, 8, 16-18, 22, 27, 29, 30...	....	991-026315-000
Q4, 7, 15	....	991-016727-000
Q5, 9, 19, 23	....	991-018238-000
Q11	....	991-026315-002
Q13	....	991-026617-000

BOARD 20

Main Tone Generator

Coil

Oscillator	 952-018874-007
------------	---------------------

Integrated Circuits

IC1-12, 14	CD4024BE	 991-028681-001
IC13	MK50240N	 991-027326-000

Network

17-Pin 100K	 949-030230-000
-------------	---------------------

Transistors

Q1	....	991-018238-001
Q2	....	991-010098-000
Q3	....	991-026315-000

BOARD 21

Lower Sustain Keyer

Diodes

Z1	Zener 3.9V 5W	 919-017406-069
All other	....	919-024769-050

Integrated Circuits

IC1, 2	EA5070	 991-022793-000
--------	--------	---------------------

Network

14-Pin 68K	 949-022779-000
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PARTS LIST

BOARD 21 (Continued)

Transistors

Q1	991-020426-001
Q2-50	991-030753-000
Q51	991-020425-001

BOARD 22

Upper Sustain Readout

Network	14-Pin 68K	949-022779-000
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BOARD 23

Upper Fractional Keyer

Integrated Circuits

IC1, 2	EA5070	991-022793-000
--------	--------	----------------

Networks

8-Pin 68K	949-022778-000
14-Pin 68K	949-022779-000

Transistors

All	991-026315-000
-----	----------------

BOARD 24

Upper Sustain Keyer

Diodes

Z1	Zener 3.9V 5W	919-017406-069
All others		919-024769-050

Integrated Circuits

IC1, 2	EA5070	991-022793-000
--------	--------	----------------

Transistors

All	991-030753-000
-----	----------------

BOARD 25A-25B

Orch. Plus Instrumentation

Coils

L1-3	Oscillator	952-018874-002
All others	70mh	956-018877-000

Diodes

D64, 65, 67, 68, 70		919-024117-000
D66, 69, 71		919-010873-005
Z1	Zener 5V 1W	919-031835-001
All others		919-024769-050

Integrated Circuits

IC1, 2	7414N	991-029864-000
IC3	DM74121N	991-029860-000
IC4	SN74LS138N	991-030236-000
IC5, 11, 17, 23, 27		
	CD4016BE	991-028679-001
IC6, 34	MC1458C	991-025244-000
IC7, 31	LM13600N	991-029876-000
IC8, 20, 35, 36, 42		
	PIC	920-028279-000
IC9, 14, 15, 19, 21, 25, 33,		
41, 44	CD4051BE	991-029868-001
IC10, 16, 22, 26		
	LM348	991-025267-000

BOARD 25A-25B (Continued)

Integrated Circuits

IC12, 13, 45		
	CD4001BE	991-026025-001
IC18, 28, 39		
	CD4011BE	991-025515-001
IC24	CD40103BE	991-029869-001
IC29	EA5076	920-030729-000
IC30, 38	MC14053B	991-031061-000
IC32, 40, 43		
	LM393	991-030254-000
IC37	LM339	991-029874-000
IC46	SN74LS02	991-029855-000
Lamp	GE73	939-026038-005
Networks		
	9 Pin	949-030231-000
	9 Pin	949-030232-000
	9 Pin	949-030233-000
Socket	DIP	906-031886-001
Switch	DIP	960-031887-003
Transistors		
	Q1, 3, 5	991-031685-000
	Q2, 4, 6, 28, 36, 41	991-013599-000
	Q7, 8, 10-13	991-010098-000
	Q9, 23, 24, 26, 27, 32, 34,	
	35, 40, 42, 43, 48	991-026315-000
	Q14, 25, 31, 33, 39, 44, 45	991-016727-000
	Q20-22	991-015587-000
	Q29, 37, 47	991-018238-000
	Q30, 38, 46	991-013544-000

BOARD 27

Repeat Flasher

Transistors

All	991-016727-000
-----	----------------

BOARD 28

Cymbal Generator

Integrated Circuits

IC1-3	MC14516B	991-031917-001
IC4	SN74LS74AN	991-030244-000
IC5, 6	SN74LS85AN	991-031918-000
IC7	ROM	920-030722-017
IC8	MC1408P8	920-031874-000
IC9	LM13600N	991-029876-000
IC10	SN74LS04N	991-029856-000

Transistors

All	991-010098-000
-----	----------------

BOARD 29

Rhythm

Diodes

Z1	5V 1W	919-031835-001
All others		919-024769-050

PARTS LIST

BOARD 29 (Continued)

Integrated Circuits

IC1-5	RC4136	991-022794-000
IC6	MM5837N	991-024108-000
IC7	PIC	920-028279-000
IC8, 9	CD4081BE	991-025517-000

Lamp GE 73 939-026038-005

Socket 14-Pin Ribbon 906-031886-002

Transistors

Q1		991-016727-000
Q4, 7, 9-13, 15-18, 21		991-026315-002
Q8		991-010098-000
Q22, 23		991-018238-000
Q24		991-028269-000

BOARD 30

Parallel Input-Output

Crystal 4MHz 921-032695-000

Diode

Z1 5V 1W 919-031835-001

Integrated Circuits

IC1, 39	SN74LS04N	991-029856-000
IC2	EA5076	920-030729-000
IC4	SN74LS377N	991-031834-000
IC6-12	PIC	920-028279-000
IC13	74LS27N	991-030720-000
IC14	DM74LS154N	991-029861-000
IC15	SN74LS155	991-030253-000
IC16, 17	F-7414PC	991-029864-000
IC18-32	ULN-2004A	991-029872-000
IC36-38	MC14511B	991-029859-000

Lamp GE 73 939-026038-005

Socket 14-Pin Ribbon 906-031886-002

BOARD 31

ROM

Diodes

Z1 5V 1W 919-031835-001

Integrated Circuits

IC1	ROM	920-030722-002
IC2	ROM	920-030722-003
IC3	ROM	920-030722-004
IC4	ROM	920-030722-005
IC5	ROM	920-030722-006
IC6	ROM	920-030722-007
IC7	ROM	920-030722-008

BOARD 31 (Continued)

ROM

Integrated Circuits

IC8	ROM	920-030722-009
IC9	ROM	920-030722-010
IC10	ROM	920-030722-011
IC11	ROM	920-030722-012
IC12	ROM	920-030722-013
IC13	ROM	920-030722-014
IC14	ROM	920-030722-015
IC15	ROM	920-030722-016
IC17	DM74LS154N	991-029861-000
IC18	DM74LS02N	991-029855-000
IC19	74LS240N	991-031063-000
IC20, 21	74LS244N	991-031060-000
IC22	DM74LS04N	991-029856-000

Network 11-Pin 10K 949-030275-000

Socket DIP 906-031886-003

Switch DIP 960-031887-008

BOARD 32

Central Processing Unit (CPU)

Crystal 6MHz 921-029879-000

Diodes

Z1	5V 1W	919-031835-001
All others		919-024769-050

Integrated Circuits

IC1	P8085A	920-029846-000
IC2, 7	74LS244N	991-031060-000
IC3, 4, 10	7414N	991-029864-000
IC5	P8212	920-029847-000
IC6	74LS240N	991-031063-000
IC8	SN74LS138N	991-030236-000
IC9	DM74LS32N	991-030721-000
IC11	74150N	991-029853-000
IC12	SN74LS00N	991-029854-000
IC13-15	MM80C95N	991-029862-000
IC20	MK4118N	920-030708-000
IC24, 25	SIC	920-028278-000
IC27	74LS10N	991-029858-000
IC29	DM74LS154N	991-029861-000
IC31	SN74LS74AN	991-030244-000
IC32	MM74C14N	991-025576-000

Transistor

Q1		991-002232-000
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PARTS LIST

BOARD 33

Golden Harp Button

Potentiometers	Controls	
Percuss	1M Log. Rev.	925-030262-005
Sustain	10K Lin.	925-030262-001
Reverb	10K Log.	925-030262-002
Repeat	10K Log.	925-030262-002
Input	10K Log. Dual	925-030267-001

BOARD 34

Solo Symp. Button

Potentiometers	Controls	
Tuning	25K Lin.	925-030262-003
Trem Depth	10K Lin.	925-030262-001
Trem Speed	100K Log. Rev.	925-030262-004
Volume	10K Log.	925-030262-002

BOARD 35

Custom Symp. Button

Potentiometers	Controls	
Filter Tune		
	100K Log. Dual Rev.	925-030267-005
Filter Resonance		
	25K Log. Dual	925-030267-003
Filter Range		
	25K Log. Dual	925-030267-003
Envelope Attack		
	175K Log. Dual	925-030267-006
Envelope Decay		
	1M Log. Dual	925-030267-007
Envelope Sustain		
	10K Log. Dual	925-030267-001

BOARD 36

Orch. Symp. Button

Potentiometers	Controls	
Upper	10K Log.	925-030262-002
Lower	10K Log.	925-030262-002
Pedal	10K Log.	925-030262-002
Tuning	25K Lin.	925-030262-003
Trem Depth	10K Lin.	925-030262-001
Trem Speed	100K Log. Rev.	925-030262-004
Volume	10K Log.	925-030262-002

BOARD 37

Rhythm Button

Potentiometers	Controls	
Rhythm Volume		
	10K Log. Dual	925-030267-001

BOARD 37 (Continued)

Potentiometers	Controls	
Rhythm Speed		
	10K Lin. Dual	925-030267-002
Orchestration		
	10K Log. Dual	925-030267-001
Genie		
	10K Log.	925-030262-002
Slide Switch	Rhythm Speed	960-030247-000

BOARD 38

Flute Preset Potentiometer

Potentiometers	Controls	
All	10K Log.	925-030262-002

BOARD 39

Headphone Jack

Jacks	Headphone	910-031034-000
	Out, In	910-031035-001
Socket	Pushbutton Switch	906-031913-000
Switch	Pushbutton	960-031875-013

BOARD 41

Effects Tab

Transistor	Q1	991-026315-002
------------	--------------	----------------

BOARD 44

Digital Readout

Diode		
	Digital Display	7 Segment
		919-031873-000
Socket		
	Digital Display	14-Pin
		906-030238-000

BOARDS 45, 46, 48 & 49

Upper & Lower Keyswitch

Contacts	Adjustable	918-030271-000
	Spring	917-030509-000

Integrated Circuits

All	MC14021B	991-029866-000
-----	--------------------	----------------

BOARD 50

Regulator

Diodes		
	D1-3	919-024769-050

PARTS LIST

BOARD 50 (Continued)

Diodes		
D4	.....	919-010459-000
D5	.....	919-010623-000
Z1	9.1V 5W	919-017406-026
Z2, 3	3.3V 5W	919-017406-018
Z4, 7	15V 1/2W	919-026799-068
Z5	15V 5W	919-017406-013
Z6	18V 5W	919-017406-003
Z8	30V 1/2W	919-026799-079

Clip Fuse 976-026063-000

Fuse 6-Amp Fast-Blo . 939-001197-004

Integrated Circuits

All LM723 991-029875-000

Relays

K1 4-PDT 921-024167-000

K2 2-PDT 921-029096-000

Transistors

Q5 991-020426-001

Q6 991-026315-002

Q7, 8 991-026617-000

BOARD 51

Crossover

Integrated Circuits

IC1 CA3080E 991-021444-001

IC2 MC1458C 991-025244-000

Transistors

Q4 991-026315-000

Q5-9 991-018238-000

BOARDS 52-57

Amplifiers

Clip Fuse 976-026063-000

Fuse 3-Amp Fast-Blo . 939-001197-003

Lamp GE 73 939-026038-005

Transistors

Q10-12 991-026617-000

Q13 991-015614-000

Q16 991-013544-000

BOARD 58

AC Distribution

Clip Fuse 976-026063-000

BOARD 58 (Continued)

Diodes

D1-6 919-010459-000

D7 919-010623-000

Fuses

3-Amp Fast-Blo . 939-001197-003

5-Amp Slo-Blo . 939-013304-004

6-Amp Fast-Blo . 939-001197-004

Relay

SPST 921-031617-000

Thermister

..... 921-031871-000

BOARDS 59 & 60

Pedalswitch

Contacts Bus Bar 918-029537-001

Spring 917-030494-000

Holder

Bus Bar 964-030791-000

AC CHASSIS ASSEMBLY

Cord Power 989-008717-000

Diodes

All Bridge Rectifier,
30-Amp 919-029090-000

Transformers

T1 954-031889-000

T2 945-031832-000

BASS PEDAL ASSEMBLY

Actuator Pedalswitch 964-030990-000

Caps Natural 978-031881-000

Sharp 915-003863-000

Channels

Natural 966-005102-010

Sharp 966-005103-008

Spring

Compression ... 975-005811-000

BENCH ASSEMBLY

Bench Walnut 978-031989-001

CONSOLE ASSEMBLY

Console Walnut 978-029588-001

Endblocks

Walnut

Upper Left Hand 978-029575-002

Right Hand 978-029574-002

Lower Left Hand 978-029577-002

Right Hand 978-029576-002

PARTS LIST

CONSOLE ASSEMBLY (Continued)

Lamp		
Bass Pedal	GE 70 ..	939-026038-004
Lens		
Bass Pedal	.....	922-029251-000
Rack	Music	978-026308-000
Rail	Upstop	936-031921-000
Socket		
Lamp	Bass Pedal	906-029256-000
Spring	Reverb Unit	984-017447-000
Speakers		
Bass	10-inch 8-ohm ..	985-031928-000
Chorus	6x9-inch 8-ohm ..	985-031994-000
Flute & Main	8-inch 8-ohm	985-003185-004

EXPRESSION SHOE ASSEMBLY

Contacts	Bus Bar	918-004399-001
	Spring	917-029542-000
Diffuser	White	922-015938-001
Glide Switch Assembly	.....	997-030835-000
Lamp	GE 70	939-026038-004
Minor Switch Assembly	.....	997-030837-000
Pedal/Mat	Assembly	997-030391-000
Photocell	P1	948-029970-000
Shield	Light	922-029976-000
Socket	Lamp	906-029256-001
Spring	Compression ...	975-022949-000

POWER SUPPLY & AMPLIFIER TRAY

Insulators	IC/Transistor ...	908-002346-001
Integrated Circuits		
+8 Volt Reg.	LAS 1608 ..	992-031880-003
+15 Volt Reg.	LAS 1612 ..	992-031880-005
+39 Volt Reg.	LM340-24K	992-024149-014
-15 Volt Reg.	LM320-15K	992-026646-010
Transistors		
Q1-4, 14	.....	992-026039-002
Q15	.....	992-026040-002
Q17	.....	992-026315-001

TAB PANEL ASSEMBLY

Diodes	All	919-021084-000
Halogen Lamp Assembly		
Left Hand	.....	997-032120-000
Right Hand	.....	997-032119-000
Knobs		
Controls	Black	915-030496-006
	Brown	915-030496-007
	Red	915-030496-001
	Yellow	915-030496-002
	Green	915-030496-003
	Blue	915-030496-004
	White	915-030496-005
Switches	Black	915-030496-006
Lamps		
Halogen	GE 773	939-031839-000
Tab Panel	GE 73	939-026038-002
Lens	Cancel Accomp.	922-027397-012
	Cancel Accomp. Insert	922-029581-012
Socket		
Lamp	Tab Panel	906-030110-001
Switches	Cancel Accomp. ..	960-029224-000
	Lights	960-031830-000
	Power	960-028213-002

TABSWITCH ASSEMBLY

Contacts	Bus Bar	918-029537-001
	Spring	917-030494-000
Guide	Slider	976-030904-000
Holder	Bus Bar	964-030791-000
Lamp	GE 73	939-026038-002
Pusher	Medium	964-025555-000
Tabs		
Bass	Pedal Sustain ...	915-025544-251
	Pedal 16	915-025544-252
	Pedal 8	915-025544-253
	Diapason 8	915-025544-254
	Diaphone 16 ...	915-025544-255
	Guitar Bass	915-025544-256
	Bass Medium ...	915-025544-257
	Bass Full	915-025544-258
Magic Genie	Genie Bass	915-025544-261
	Bass Plus	915-025544-308
	Magic Genie Chords	915-025544-263
	Magic Key Memory	915-025544-264

PARTS LIST

TABSWITCH ASSEMBLY (Continued)

Lower	Piano	915-025544-269
	Guitar	915-025544-270
	Banjo	915-025544-271
	Diapason 8	915-025544-272
	Vox Humana 8	915-025544-273
	Flute 8	915-025544-274
	Flute 4	915-025544-275
	Flute 2	915-025544-276
	Lower Med.	915-025544-259
	Lower Full	915-025544-260
Upper	Trombone 16 ...	915-025544-286
	Clarinet 16	915-025544-287
	Cornet 16	915-025544-288
	Kinura 8	915-025544-289
	Flute 16	915-025544-277
	Flute 8	915-025544-274
	Flute 5-1/3	915-025544-279
	Flute 4	915-025544-275
	Flute 2-2/3	915-025544-281
	Flute 2	915-025544-276
Presets	Flute 1	915-025544-283
	Upper Flute Preset	915-025544-265
Effects	Custom Flute Preset	915-025544-213
	Sustain Upper ..	915-025544-292
	Sustain Lower ..	915-025544-293
	Upper String Attack	915-025544-294
	Marimbo Repeat ..	915-025544-295
	Vibrato	915-025544-296
Harmony	AOC Organ	915-025544-297
	AOC Symphonic ..	915-025544-298
	AOC Open Harmony	915-025544-299
Percussion	Percuss Long ...	915-025544-267
	Repeat Percuss ..	915-025544-268
Stereophaze	Vibra Trem Flutes	915-025544-284
	Sound	
	Flute Chorus ...	915-025544-285
	Main Chorus ...	915-025544-290
	Chorus Celeste ..	915-025544-291
Shaft	Tabswitch	974-009804-023
Socket		
	Lamp	
Spring	Tabswitch	906-031831-000
	Toggle	975-031997-001

UPPER/LOWER KEYBOARD ASSEMBLY

Actuator	Keyswitch	964-030504-000
Bumper	Upstop	916-026019-000
Guide	Natural	916-026009-000
	Sharp	916-026009-002

UPPER/LOWER KEYBOARD ASSEMBLY
(Continued)

Keys	Black	964-030251-000
	White A	964-030250-001
	White B	964-030250-002
	White C	964-030250-003
	White D	964-030250-004
	White E	964-030250-005
	White F	964-030250-006
	White G	964-030250-007
	White High C ...	964-030250-010
	White High F ...	964-030250-009
Spring	Key Tension	975-032268-000

GENERAL

Cable		
	Ribbon	
	14 Conductor ..	957-031838-000
	40 Conductor ..	957-031837-000
Capacitors	Electrolytic	
	1 uf 35V	945-030702-004
	1 uf 50V	945-026783-014
	1 uf 50V NP	945-028285-003
	2.2 uf 25V	945-026783-001
	2.2 uf 63V	945-026783-017
	2.2 uf 16V NP ..	945-028285-002
	3.3 uf 25V	945-026783-015
	3.3 uf 16V NP ..	945-028285-001
	4.7 uf 16V	945-026783-002
	4.7 uf 35V	945-030702-003
	4.7 uf 63V	945-026783-018
	10 uf 16V	945-026783-004
	10 uf 25V	945-026783-010
	10 uf 100V	945-026783-020
	22 uf 16V	945-026783-016
	22 uf 25V	945-026783-005
	22 uf 50V	945-030702-005
	22 uf 63V	945-026783-019
	47 uf 25V	945-026783-021
	100 uf 16V	945-026783-006
	100 uf 35V	945-026783-007
	220 uf 16V	945-026783-012
	470 uf 16V	945-026783-011
	470 uf 63V	945-026783-028
	1000 uf 35V	945-026783-026
	2200 uf 63V	945-030278-004
	4700 uf 50V	945-030278-003
	10,000 uf 16V ..	945-030278-001

PARTS LIST

GENERAL (Continued)

Capacitors		Tantalum	
	.47 uf 35V	.....	946-012624-474
	.68 uf 35V	.....	946-012624-684
	.82 uf 25V	.....	946-021452-003
	1 uf 35V	.....	946-021452-002
	2.2 uf 35V	.....	946-012624-225
	5.6 uf 25V	.....	946-021452-001
	10 uf 15V	.....	946-021452-008
	22 uf 16V	.....	946-021452-010

Diodes

LED	Amber	.....	919-030266-003
	Green	.....	919-030266-005
	Red	.....	919-030266-002
	Yellow	.....	919-030266-004
	Red/Green	.....	919-031836-000
All others		.....	919-024769-050

Posts

PCB Mounting			
AC Chassis	.....		964-029299-004
Shelf	.....		964-032257-000
Trays	1, 2, 3	.....	964-029299-002
Amp & Power Supply	.....		964-031915-005

Potentiometers Adjustment

5K	.....	925-030239-004
10K	.....	925-030239-005
25K	.....	925-030239-006
50K	.....	925-030239-007
100K	.....	925-030239-008
500K	.....	925-030239-010

Resistors

.1 ohm 5W	.....	924-031689-002
.18 ohm 2W	.....	924-008896-021
.18 ohm 5W	.....	924-008896-029
1 ohm 5W	.....	924-031689-003
1.5 ohm 50W	.....	924-030240-001
2 ohm 5W	.....	925-031689-004
2.5 ohm 10W	.....	924-031919-001
4 ohm 5W	.....	924-008896-049
4.7 ohm 2W	.....	924-010471-047
15 ohm 2W	.....	924-010471-150
18 ohm 10W	.....	924-031919-003
25 ohm 10W	.....	924-031919-002
47 ohm 2W	.....	924-010471-470
68 ohm 5W	.....	924-008896-009
100 ohm 2W	.....	924-010471-101
150 ohm 2W	.....	924-010471-151
470 ohm 2W	.....	924-010471-471

GENERAL (Continued)

Sockets

Connectors		Rear Entry	
	3-pin	.....	906-032248-003
	4-pin	.....	906-032248-004
	6-pin	.....	906-032248-006
	7-pin	.....	906-032248-007
	8-pin	.....	906-032248-008
	9-pin	.....	906-032248-009
	10-pin	.....	906-032248-010
	11-pin	.....	906-032248-011
	12-pin	.....	906-032248-012
	13-pin	.....	906-032248-013
	14-pin	.....	906-032248-014
	15-pin	.....	906-032248-015

Side Entry

3-pin	.....	906-030992-003
5-pin	.....	906-030992-005
6-pin	.....	906-030992-006
8-pin	.....	906-030992-008

Top Entry

3-pin	.....	906-030148-003
4-pin	.....	906-030148-004
5-pin	.....	906-030148-005
6-pin	.....	906-030148-006
7-pin	.....	906-030148-007
8-pin	.....	906-030148-008
9-pin	.....	906-030148-009
10-pin	.....	906-030148-010
11-pin	.....	906-030148-011
12-pin	.....	906-030148-012
13-pin	.....	906-030148-013
14-pin	.....	906-030148-014
15-pin	.....	906-030148-015

Integrated Circuits

8-pin	.....	906-021448-000
14-pin	.....	906-018905-000
16-pin	.....	906-018905-001
18-pin	.....	906-018905-004
20-pin	.....	906-018905-005
24-pin	.....	906-018905-002
40-pin	.....	906-022727-000

Switches

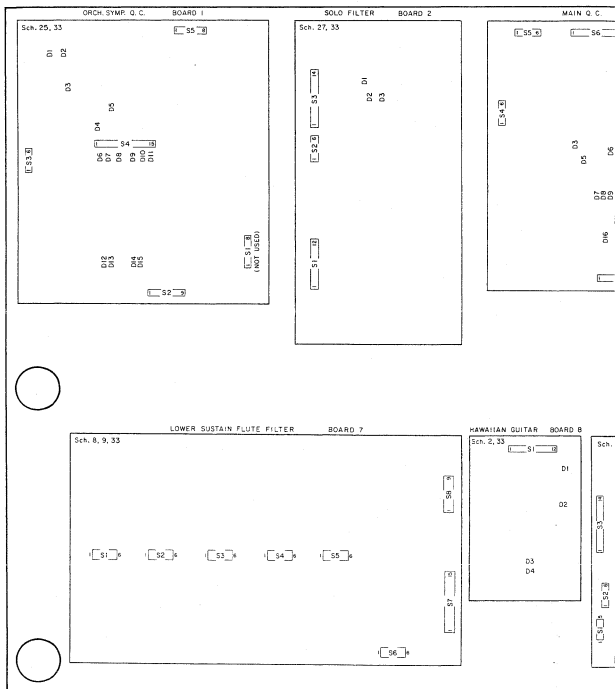
Amber	.....	960-031875-008
Blue	.....	960-031875-007
Clear	.....	960-031875-004
Green	.....	960-031875-005
Purple	.....	960-031875-010
Red	.....	960-031875-003
Smoke Brown		960-031875-009
Smoke Grey		960-031875-006
Yellow		960-031875-001

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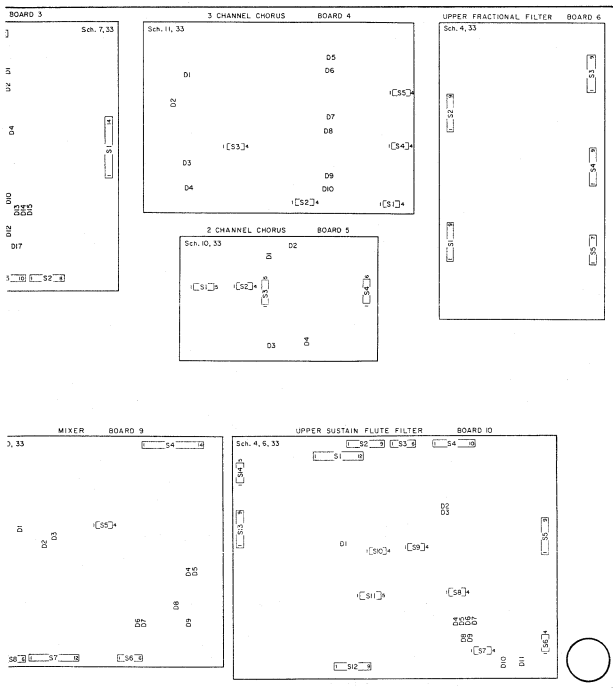
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BOARD LOCATION

TRAY 1 UP

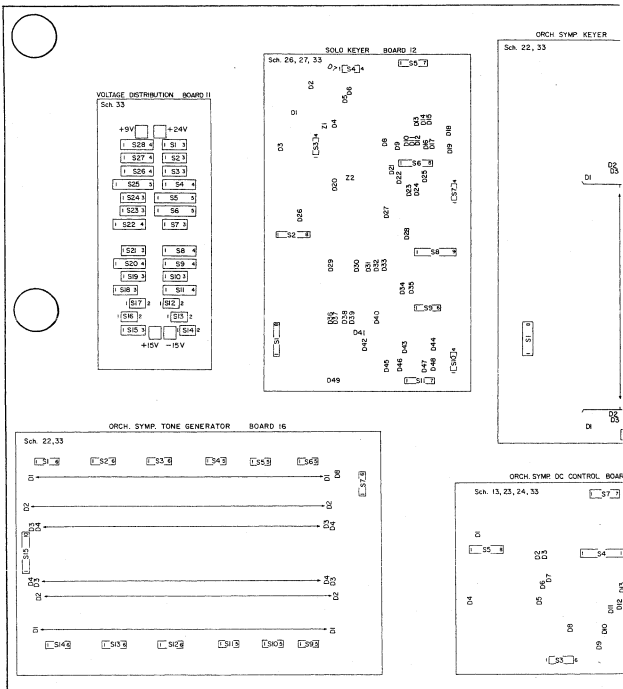


BOARD LOCATION



BOARD LOCATION

TRAY 1 DOWN

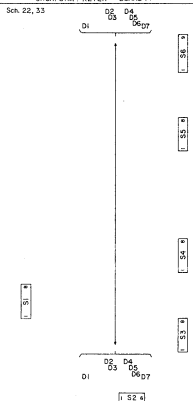


BOARD LOCATION

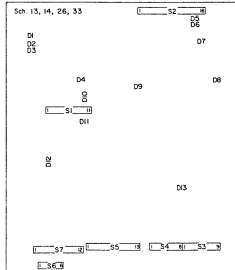
BOARD 13



ORCH. SYMP. KEYS BOARD 14



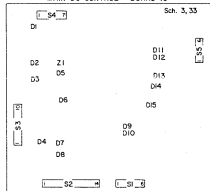
KEYBOARD ENCODER BOARD 15



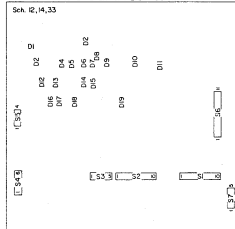
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MAIN DC CONTROL BOARD 18

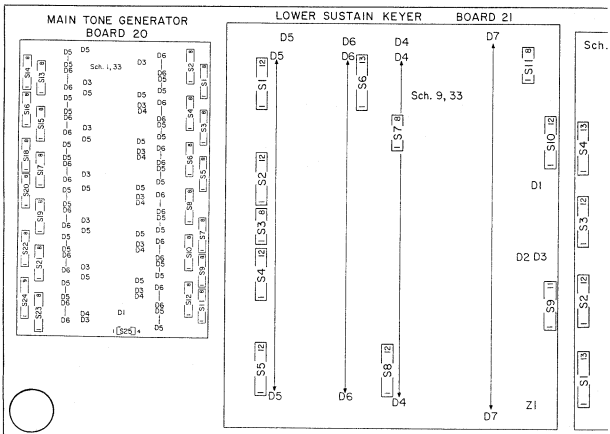


PEDAL KEYS & FILTER BOARD 19



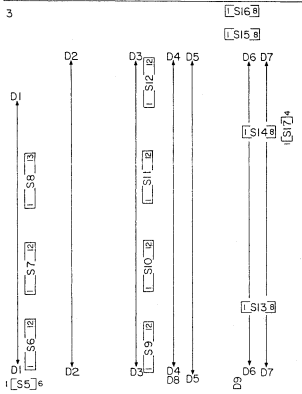
BOARD LOCATION

TRAY 2 UP

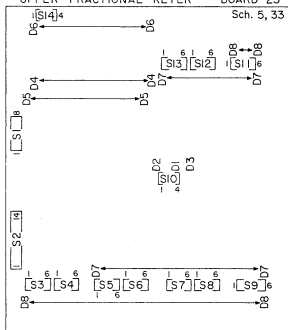


BOARD LOCATION

UPPER SUSTAIN READOUT BOARD 22

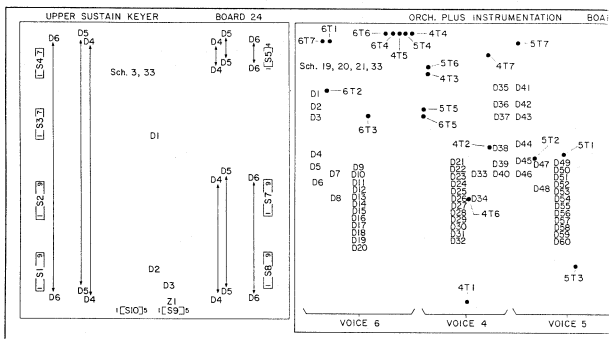


UPPER FRACTIONAL KEYER BOARD 23

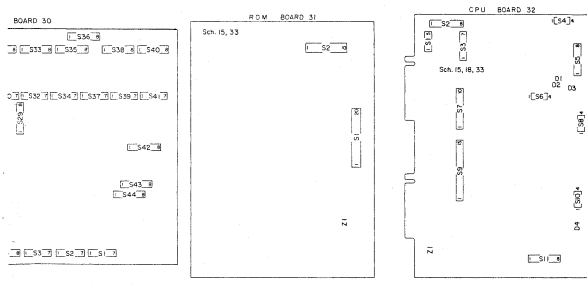
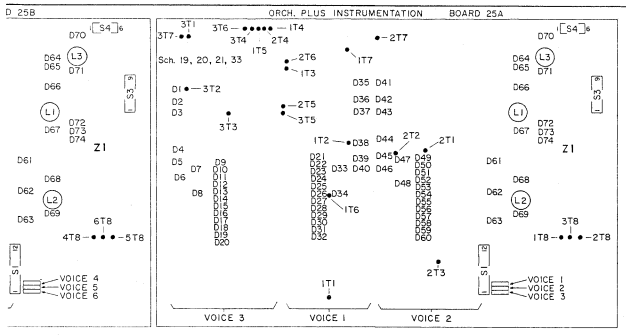


BOARD LOCATION

TRAY 3 UP



BOARD LOCATION



BOARD LOCATION

BUTTON, TAB & KEYSWITCH BOARDS

GOLDEN HARP BUTTON BOARD 33

☐ S2 ☐ S4 ☐ S6
☐ S1 ☐ S3 ☐ S5 ☐ S7
 Sch. 3, 7, 16, 18, 30 D5 D4 D3 D2 D1
 D10 D9 D8 D7 D6
 D15 D14 D13 D12 D11

RIGHT
SIDE PANEL

Sch. 30, 31

☐ S1

D2

HEADPHONE
BOARD 39

CHORUS TAB BOARD 40

Sch. 3, 10, 11, 13, 30, 33

☐ S1

☐ S2

☐ S3

SOLO SYMP. BUTTON BOARD 34

☐ S1 ☐ S3
☐ S2 ☐ S4
 Sch. 17, 18, 26, 27 D4 D3 D2 D1
 D8 D7 D6 D5
 D12 D11 D10 D9

CUSTOM SYMP. BUTTON BOARD 35

☐ S1 ☐ S2 ☐ S4
☐ S3
 Sch. 17, 18, 24, 25, 27, 33 D3 D2
 D6 D5 D4 D3
 D12 D11 D10 D9

ORCH. SYMP. BUTT

☐ S1 Sch. 3, 9, 12
☐ S2
 D6 D5 D4 D3
 D12 D11 D10 D9
 D18 D17 D16 D15

EFFECTS TAB BOARD 41

Sch. 3, 9, 13, 14, 32

☐ S1

☐ S2

UPPER TAB BOARD 42

Sch. 4, 7, 8, 32, 33

D6 D5 D4 D3 D2 D1

☐ S1

☐ S2

☐ S3

UPPER KEYSWITCH BOARD 45

Sch. 13

☐ S1
☐ S2
☐ S3

LOWER KEY

Sch. 14

☐ S1
☐ S2
☐ S3

BOARD LOCATION

LEFT SIDE PANEL

FLUTE PRESET POT BOARD 38

☐ S1 ☐ 3	☐ S2 ☐ 7	☐ S3 ☐ 8
Sch. 4, 8, 16, 18		
		D1 ☐ 10
		D2 ☐ 11
		D3 ☐ 12

PEDAL TAB BOARD 47

Sch. 18, 32, 33		
D		
☐ S1 ☐ 8	☐ S2 ☐ 6	☐ S3 ☐ 5

BOARD 36

18, 23, 25, 33	☐ S6 ☐ 5
☐ S4 ☐ 3	☐ S5 ☐ 8
D2 D1	
D8 D7	
D1/4 D13	

RHYTHM BUTTON BOARD 37

☐ S1 ☐ 24	☐ S3 ☐ 14	☐ S5 ☐ 3	☐ S7 ☐ 19
☐ S2 ☐ 13	☐ S4 ☐ 11	☐ S6 ☐ 20	
D13 D12 D11 D10	D9 D8 D7	D6 D5 D4 D3 D2 D1	
Sch. 7, 16, 18, 28, 30			
D26 D25 D24 D23	D22 D21 D20	D19 D18 D17 D16 D15 D14	
D38 D37 D36 D35	D34 D33	D32 D31 D30 D29 D28 D27	

LOWER TAB BOARD 43

Sch. 7, 8, 12, 14, 16, 32, 33		
☐ S1 ☐ 7	☐ S2 ☐ 8	☐ S3 ☐ 11

Sch. 17

☐ S1 ☐ 4	☐ S2 ☐ 5
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DIGITAL READOUT BOARD 44

5-NOTE KEYSWITCH BOARD 46

Sch. 13	
☐ S2 ☐ 3	☐ S1 ☐ 3
☐ S2 ☐ 5	

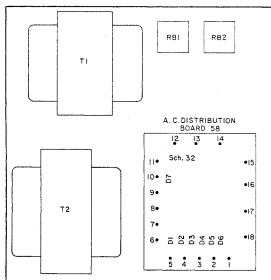
ITCH BOARD 48

5-NOTE KEYSWITCH BOARD 49

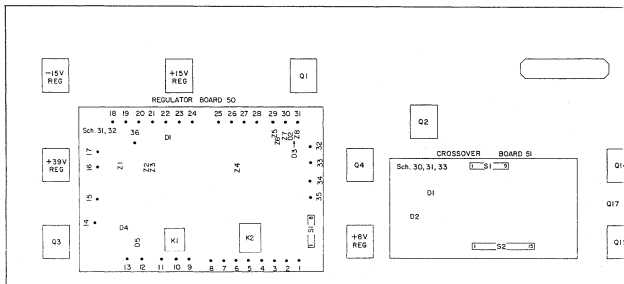
Sch. 14	
☐ S2 ☐ 3	☐ S1 ☐ 3
☐ S2 ☐ 5	

BOARD LOCATION

AC CHASSIS & PEDAL SWITCH BOARDS



5 NOTE PEDAL SWITCH
Sch. 14 (S1) 14



POWER SUPPLY & AMP TRAY DOWN

BOARD LOCATION

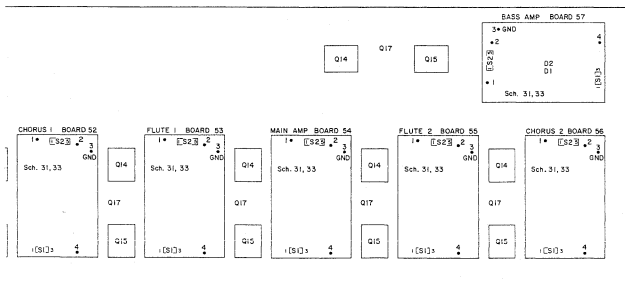
BOARD 59

13 NOTE PEDAL SWITCH

BOARD 60

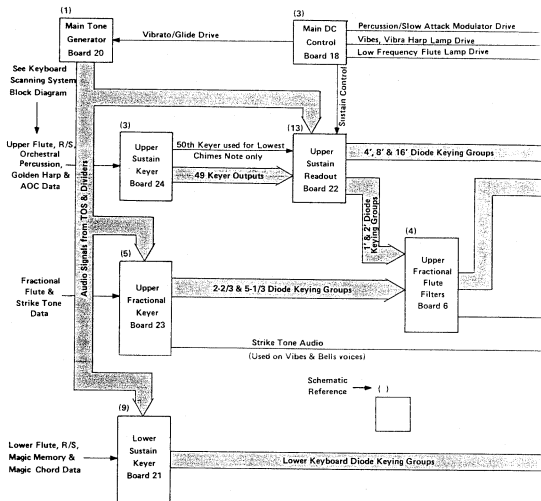
Sch. 14

1 51 2



CIRCUIT DESCRIPTION

UPPER/LOWER KEYBOARD



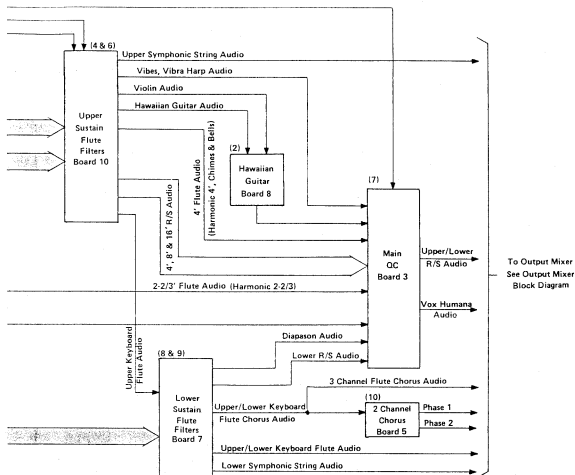
UPPER/LOWER KEYBOARD [Schematics 3, 5 & 9]

UPPER KEYBOARD

Data for keying the upper keyboard voices is produced by the keyboard scanning system and the keyboard encoder. (See keyboard and pedal scanning system block diagram.) This positive data is routed to the upper keyboard Decoders IC1 and IC2 (3-B9) where it is shifted into IC1 and IC2 by the scan clock at pin 2. At time point 67 the data is lined up at its correct position and a strobe pulse occurs causing the outputs where data appears to switch to a tri-state condition. When an output switches to a tri-state condition, the 15K pulldown resistor at the base of the PNP keyers Q1-Q49 (3-B9) causes the keyer to turn on, supplying voltage to the upper diode readout circuits (3-C11). This voltage also charges a 47 uf sustain capacitor. The discharge time of this capacitor is controlled by varying the voltage on the base of Q11 (3-E10), the more positive this base voltage the longer the sustain envelope. The voltage applied to the readout circuits allows audio signal from the tone generators to pass, forming the 1-, 2-, 4-, 8- and 16-foot diode keying groups. The 1- and 2-foot groups are routed to the Upper Fractional Flute Filter Board where the 1- and 2-foot flute filters are located. The 4-, 8- and 16-foot groups are routed to the Upper Sustain Flute Filter Board. Each footage including the fractional footages are filtered to produce the 7 upper keyboard flute footages. The output of each set of filters is routed to a preamp (4-F2). The output of each preamp is routed to a flute switcher and to a Custom Preset Volume Control. (The output of the

CIRCUIT DESCRIPTION

(Affects the following Organ Sections: All Upper/Lower Keyboard Tabswitch Voices, Symphonic String Button and Orchestral Percussion Button Sections.)



2-2/3- and 4-foot flute preamps are also routed to the Main QC to produce the harmonic 2-2/3- and 4-foot, chimes and bell voices.) Selecting a flute tabswitch allows this signal to pass to the upper keyboard Flute Mixing Preamp IC4C (4-B5). If the Custom Flute preset tab is on, the Flute tabswitch voltage is removed and Switcher Q6 (4-C2) is turned on allowing Flute audio to pass through the Custom Preset Volume Controls. All upper keyboard flute signal is combined by IC4C (4-B5) before being routed to the Lower Sustain Flute Filter Board where upper and lower keyboard flute signal is combined by the Flute Mixing Preamp IC1D (8-A3). The combined upper and lower flute audio is routed to the output mixer and also to the 2-channel chorus board. Turning on the Vibra Trem tabswitch (30-F5) allows the phase 1 and 2 outputs from the 2-channel chorus board to pass through Switcher Q6 & Q7 (30-E7) to the Flute 1 and 2 Output Amps Q12 & Q13 (30-E12). Turning on the Flute Chorus tabswitch (30-H2 & 30-F5) also allows the flute audio to pass through IC7A (30-G6) to the three channel chorus circuit (11-H9). The phase 1, 2 & 3 outputs of the 3-channel chorus modulator are then routed to the chorus 1 & 2 & main output amps (30-E12) producing a total of five chorus channels.

The 4- & 8-foot diode groups are also routed to the upper symphonic string filters (Dwg. 6) where the violin and viola voices are created. The audio for the cello symphonic string voices is taken from the output of the 16-foot Harmonic Mixers IC1C (4-E10) which is a combination of the 4-, 8- & 16-foot R/S signals. The upper symphonic string audio is routed through preamp IC4B (6-B2) to

CIRCUIT DESCRIPTION

modulator IC5 (6-B3) where the signal is volume controlled before being routed through Q4 (4-A3) to the output mixer. At the output mixer the signal is routed through the chorus audio mixer IC7A (30-G6) to the 3-channel chorus circuit (11-H9). The phase 1, 2 and 3 outputs from the 3-channel chorus are then routed into the Chorus 1 & 2 and Main Volume Regulators (30-B9). The string audio at the output of IC4B (6-B2) is also routed to Squelch Amplifier IC6B (30-G6). This signal is rectified and used to turn off Squelch Switchers Q8, 9 & 10 (30-G10) allowing the Phase 1, 2 & 3 chorus output audio to pass.

The 4-, 8- & 16-foot R/S signals are created by combining the diode keying groups through resistors at the inputs of the 4-, 8- & 16 R/S Preamps (4-G6, 9 & 10). The output of the 4-foot R/S Preamp IC2B (4-G6) is routed to the Hawaiian Guitar board (2-G2). This signal is phase modulated then routed to the main QC where it is filtered to produce the Orchestral Percussion Violin voice. The output of the 8-foot R/S Preamp IC2C (4-G9) is also routed to the Hawaiian Guitar board (2-G1). The signal is phase modulated then routed to the main QC where it is filtered to produce the Orchestral Percussion Hawaiian Guitar voice. The output of the 16-foot R/S Preamp IC3A (4-G10) is routed to the main QC (7-G5) and filtered to produce the Orchestral Percussion Accordion voice and the Clarinet tabswitch voice. The 4- and 8-foot R/S signals are combined by 8-foot Harmonic Mixers IC1A&B (4-E9). The output of the mixer is routed to the main QC (7-G3) where the audio is filtered to produce the Orchestral Percussion Accordion voice and the Kinura tabswitch voice. The 4-, 8- & 16-foot R/S signals are combined by the 16-foot Harmonic Mixers IC1C&D (4-E10). The output of the mixer is routed to the main QC (7-G7) where the audio is filtered to produce the Cornet and Trombone tabswitch voices. This audio is also routed on board to the Cello switcher (6-E1) and is used for the upper symphonic string cello voice. All upper and lower R/S audio is combined by the R/S Mixing Preamps IC3C&D (7-A5) and routed to the output mixer (30-D4) where the higher R/S frequencies are channeled to the Flute 1 Volume Regulator IC1 (30-D11) the remaining R/S frequencies are channeled to the Main Volume Regulator IC3 (30-E11). Turning on the Main Chorus tabswitch (30-E5) channels the R/S audio into the Chorus Audio Mixer IC7A (30-G6) where it is routed to the 3-channel chorus circuit (11-H9) and gives the R/S voices a chorus effect.

FRACTIONAL FLUTE AND STRIKE TONE

The data for keying the above voices is produced by the keyboard scanning system and the keyboard encoder. (See keyboard and pedal scanning system block diagram.) The fractional flute and strike tone data is inverted data which is routed to the Fractional Flute and Strike Tone Decoders IC1 & IC2 (5-H1) where it is shifted into IC1 & IC2 by the scan clock at pin 2. At time point 67 the data is lined up at its correct position and a strobe pulse occurs causing the outputs where data appears to switch high (+23V). The first 49 positions of IC1 and IC2 are used to key the fractional flute audio signals. When one of these outputs switches high, a positive voltage is applied to a 2-2/3 and 5-1/3 keying diode allowing audio signal from the tone generators to pass forming the 2-2/3 and 5-1/3 diode keying groups. The 2-2/3- and 5-1/3-foot diode keying groups are routed to the upper fractional flute filter board (4-H4) where the audio signal is filtered to produce the 2-2/3- and 5-1/3-foot Flute voices. The audio signal for each footage is then routed through a preamp (4-F4&5) to the upper sustain flute filter board where it is combined with the other upper flute footages and channeled as previously described under the upper keyboard heading.

The last twelve positions of IC1 & IC2 produced the strike tone frequency that is used for the Bells and Vibes voices. With the Bells or Vibes on, a positive voltage (+23V) is applied through a strike tone keyer transistor (5-D2) to a keying diode allowing audio signal to pass to the strike tone filter (7-F2). The strike tone frequency is a semi-tone different from the key being played. For example, playing any C on the keyboard keys a B8 octave frequency for the strike tone frequency. A chart is shown on Dwg. 5 which indicates the octave frequency being used for each keyboard note played. Turning on the Bells or Vibes allows the filtered strike tone frequency to pass through preamps IC4B&A (7-C1&B3) to the R/S Mixing Preamps IC3C&D (7-A5) where it is combined with the other upper R/S voices and channeled as previously described under the upper keyboard heading.

LOWER KEYBOARD

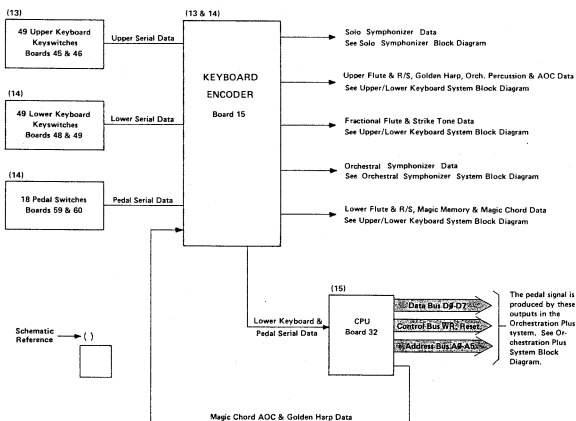
The data for keying the lower keyboard voices and features is produced by the keyboard scanning system and the keyboard encoder. (See keyboard and pedal scanning system block diagram.) This positive data is routed to the lower keyboard decoders IC1 & IC2 (9-H4) where it is shifted into IC1 & IC2 by the scan clock at pin 2. At time point 67 the data is lined up at its correct position and a strobe pulse occurs causing the outputs where data appears to switch to a tri-state condition. When an output switches to a tri-state condition the 22K pull down resistor at the base of the PNP keyers Q2-Q50 (9-F4) causes the keyer to turn on, supplying voltage to the lower diode readout circuits (9-F4). This voltage also charges a 22 uf sustain capacitor, the discharge time of this capacitor is dependent on the position of the sustain lower tabswitch. The voltage applied to the readout circuits allows audio signal from the tone generators to pass forming the 2-, 4- & 8-foot lower diode keying groups. The lower diode keying groups are routed to the lower sustain flute filter board where each footage is filtered to produce the lower 2-, 4- & 8-foot flute voices. The output of each set of filters is routed to a preamp (8-F3, 5 & 10). The output of each flute preamp is routed to a flute switcher and to a Custom Preset Volume Control. Selecting a flute tabswitch allows this signal to pass to the Lower Keyboard Flute Preamp IC1C (8-B3). If the Custom Flute Preset tab is on, the flute tabswitch voltage is removed and Switcher Q52 (9-C1) is turned on allowing flute audio to pass through the Custom Preset Volume Controls to the lower keyboard flute preamp. The signal volume is controlled at the output of the Lower Keyboard Flute Preamp IC1C before being mixed with the upper flute signal by IC1D (8-A3). From this point the signal is channeled as described previously under the upper keyboard heading.

The 4- & 8-foot diode keying groups are also routed to the lower symphonic string filters (Dwg. 9) where the lower violin and viola voices are created. The lower symphonic string audio is routed through Lower Symphonic String Preamp IC2D (8-C2) to the Lower Symphonic String Volume Regulator IC4 (9-B2) where the signal volume is controlled by the lower Symphonic String Volume Control (9-C3) before being routed through Q50 to the output mixer. Here the lower symphonic string audio is routed into the 3-channel chorus modulator in the same manner as the upper symphonic string signal which was described previously under the upper keyboard heading. The lower symphonic string audio at the output of IC2D (9-C2) is routed to the output mixer (30-H4) where it is rectified and used to turn off the Squelch Switchers Q8, 9 & 10 (30-G10) allowing the chorus phase 1, 2 & 3 audio outputs to pass.

The lower R/S signal is created by combining the 4- & 8-foot diode keying groups through resistors at the input of the 8-foot Harmonic Mixer IC2A (8-G6). The diapason signal is created by combining the 4- & 8-foot diode keying groups through mixer transistors (8-H7). The output of each mixer is then routed to 1 of 7 diapason filters. The combined filter outputs are then routed to the diapason preamp IC1A (8-E8). The R/S audio output from IC2A (8-G6) and the diapason audio output from IC1A (8-E8) are then routed to the main QC board (7-F7 & H10). The R/S audio is routed through piano, banjo and guitar filters (7-D8) to the lower keyboard modulator where these voices are modulated at the speed of the rhythm. If more than one of these voices is selected, the voices applied to the modulator are controlled by the Genie Accent circuit (see Truth Table in Drawing 7 Waveforms). The output of the modulator is routed through Lower Keyboard Preamp IC3A (7-C8), and the Genie Volume Control to the R/S Mixing Preamp IC3C (7-B5). The diapason audio is routed through switcher Q21 (7-F10) to the R/S mixing preamp. Here the R/S and diapason audio combines with the upper R/S audio and is channeled to the output mixer as described previously under the upper keyboard heading. The Vox Humana audio is taken from the Vox Humana Preamp IC3B (7-A11) and routed directly to the 3-channel chorus input of the output mixer (30-H4) giving the Vox Humana voice a preset chorus effect.

CIRCUIT DESCRIPTION

KEYBOARD & PEDAL SCANNING SYSTEM



KEYBOARD & PEDAL SCANNING SYSTEM [Schematic 13 & 14]

[Number-letter designation shown in parenthesis are schematic numbers and map coordinates where component is located.]

The scanning for upper, lower keyboard and pedals is done with parallel/serial shift registers. The timing and clock signals for the scan are controlled by the microprocessor through the SIC II IC25 (15-G7). The clock and timing signals are not shown in the block diagram above. A BOS (begin of scan) pulse strobes the parallel/serial shift registers loading the registers with any keydown information. The scan clock shifts this data through the registers creating 3 serial data streams: one for upper keyboard, one for lower keyboard and one for pedals. The BOS pulse occurs at time point 1 for upper keyboard, time point 8 for lower keyboard and time point 67 for the pedals. The lower keyboard scan starts 8 time points later to align upper and lower keys to scan at the same time point. For example, time point 8 for the upper scan would be Key F4, at this time the lower scan starts and the first key scanned is F5.

UPPER KEYBOARD SERIAL DATA

The upper keyboard serial data is processed in different ways and is used to key the upper keyboard Flute and R/S voices, the Orchestral Percussion voices and the Orchestral, Custom and Solo Symphonizer voices.

SOLO SYMPHONIZER DATA

The upper keyboard raw serial data is routed onto the keyboard encoder board through a 1K isolation resistor (13-A6), where it is then routed to the PNG (Priority Note Generator) (26-E6).

CIRCUIT DESCRIPTION

The PNG decodes the data into an audio frequency which is used to create the voices of the solo symphonizer and the solo voice of the custom symphonizer.

ORCHESTRAL SYMPHONIZER DATA

The upper keyboard raw serial data used for the Orchestral Symphonizer is routed through IC31 (14-C8) to a 12-bit delay which causes the data to line up at a 16-foot pitch in the Orchestral Symphonizer Decoders (22-H2). The highest note of the Orchestral Symphonizer Data also generates an octave code pulse at the collector of Q11 (14-D12). This pulse generates an octave code out of the PNG (26-C6) which causes the tuning of the Orchestral Symphonizer Voltage Controlled Filter to follow the highest keyboard note being played. This feature is only used for the Orchestral Symphonizer when the Orchestral and Filter Follow pushbuttons of the Custom Symphonizer section are on. The Orchestral Symphonizer Data is used to key all voices of the Orchestral Symphonizer, the Wow and Orchestral voices of the Custom Symphonizer.

UPPER KEYBOARD FLUTE AND R/S DATA

The upper keyboard data used to key the flute voices (except fractional flute voices) and R/S voices is routed through pin 13 of IC30 (13-C11) to the upper keyboard Decoder circuits. For the fractional flute voices this data is routed through pin 2 of IC27 (14-B8) to the fractional flute and strike tone decoders (Dwg. 5).

ORCHESTRAL PERCUSSION DATA

Except for the chimes and bells voices, all voices in the Orchestral Percussion section are keyed by the Upper Keyboard Decoders (3-B9). The audio signal for these voices is routed to the Percussion and Slow Attack Modulator IC1 (7-D4). The new keydown and any keydown signals from IC25 pin 15 (13-G4) and pin 12 (13-C2) are routed to the modulator drive circuits on the main DC control board (3-A11 and G9). These signals are used to produce the percussive or slow attack envelope that drives modulator IC1 (7-D4) and gives these voices their percussive or slow attack character.

Turning on the bells or chimes voice allows the output of the Percussion Data Collector IC36B (13-G10) to pass to the upper keyboard decoder circuits (3-A7). A new keydown pulse is developed by comparing keydown data from the current scan to keydown data of the previous scan. The previous scan data is stored in IC17 (13-D6). The new scan data and the inverse of the previous scan data are ANDed together by IC15A (13-D7) which only allows a data pulse through for a key that was not down on the previous scan. If keyswitch bounce occurs, a negative pulse is generated at the output of IC13B (13-F7). This pulse circulates through IC18 (13-E9) and is applied to Pin 6 of IC15B (13-D10) for approximately 2 scans (10mS) and blocks any erroneous data from passing through IC15B. Data passing through IC15B is inserted into register IC38 (13-G6) where it circulates for approximately 2 scans. This circulating data is routed through IC36B (13-G10) to the decoder circuits (3-A7) where the audio signal is keyed. After the circulating enable time constant at pin 6 of IC26 (13-G5) is satisfied, the data is no longer output and the keyer circuits at the output of the decoders decay (3-C9) giving these voices their percussive character. (It should be noted here that the percussive effect of the chimes and bells is produced by circulating the data in register IC38 (13-G6). The signal for these voices does not pass through modulator IC1 (7-D4) as the other orchestral percussive voices do. This creates a monophonic percussion for the chimes and bells voices, meaning that if additional keys are added only the new key played will percuss. This differs from the other Orchestral Percussion voices in that adding a new key with these voices will percuss the new key and any other keys that have already decayed and are still being held down. With the chimes on, the circulating data also loads shift registers IC39-IC41 (13-G8&9) with 3 additional data bits, these bits are loaded at pin 4 of IC41, pin 13 of IC40 and pin 13 of IC39. These bits are shifted through IC28A and IC36B (13-G1) to the decoder circuits (3-A7) where the 3 added data bits and the bit generated by keydown line up to key the four audio signals that comprise each chimes note.

STRIKE TONE DATA

The Bells and Vibes voices key a strike tone frequency at initial keydown. The new keydown data at pin 4 of IC15B (13-D10) is routed through pin 11 of IC27 (14-C4) to the Strike Tone Data Position

Register IC33 (14-C5). This data circulates around IC33 until time point 50, at that time a high level from the SIC IC25 (15-G7) is applied through Buffer IC2B (14-B3) to pin 8 of IC26 (14-B8). If Vibes or Bells are on, pin 10 of IC26 goes high enabling the strike tone data bit to pass through IC27 pin 12 (14-B9) to the strike tone decoders (5-H1). This data will line up at one of the strike tone keyer circuits (pins 9-20 on IC1) and key the appropriate strike tone frequency. The chart on Dwg. 5 shows what frequency is keyed for each keyboard note. All like notes key the same frequency. For example, all C's key a B8 octave frequency.

MARIMBA REPEAT

Turning on the Marimba Repeat tabswitch (13-F1) cancels the normal path for upper keyboard data by allowing positive voltage to reach pin 3 of IC35 (13-C10). This causes the output of IC35B to go low holding pin 12 of IC30 (13-C11) low, blocking the upper keyboard data on pin 13 of IC30 from passing. Also, with this tab on the output of Register IC21 (13-F3) is enabled along with the Data Select Flip-Flop IC20B (13-E5). Under this condition all upper keyboard data is routed simultaneously into pin 1 of register IC21 and into pin 5 of IC19 (13-F4). Register IC21 duplicates the keydown data one octave lower. This data is added to the stream through IC19B. Depending on whether Flip-Flop IC20B (13-F5) has just been set or reset, the odd numbered or even numbered data pulses are allowed to pass through data enable IC22C (13-F5). For example, assume a three-note chord is being held on the upper keyboard producing 3 data bits. Register IC21 (13-F3) duplicates these 3 bits one octave lower and adds them to the serial data stream. Now there are six data pulses in the stream. Assuming Flip-Flop IC20B has just been reset, ($\bar{Q}$ high) the first data pulse through IC19B will pass through data enable IC22C. At the same time this data pulse clocks IC30 through IC35D causing the $\bar{Q}$ output of IC20 to go low. The next data pulse will not pass through IC22C. However, it does clock IC20 ($\bar{Q}$ high) which allows the third data pulse through. On the next transition of the Marimba Speed Flip-Flop IC23B (13-D5), IC20B will start out in a set condition which will allow the even numbered data pulses to pass. For each transition of the Marimba Speed Flip-Flop the data heard alternates between the odd numbered and even numbered data creating the marimba repeat effect.

Note: If the Upper Cancel Enable Input [13-C1] is low, the Marimba tabswitch will have no effect. A Truth Table [13-B9] is provided showing when this condition is present.

GOLDEN HARP DATA

The Golden Harp data is produced by the microprocessor IC1 (15-A2). Lower keyboard data at the emitter of Q1 (14-F7) is routed to the microprocessor through Serial Interface Controller (SIC) IC25 (15-G7). If the Golden Harp footswitch (located to the right on expression shoe) is pressed and a Golden Harp direction pushbutton is selected (up, down). The microprocessor will put out the first note of the Golden Harp sequence, based on the lower keyboard keydown data. The Golden Harp note is output through SIC IC25 pin 4 (15-G8) to the input of Buffers IC1F (14-A2) and IC2A (14-C2). The data through IC2A enters the strike tone register and is output to the Strike Tone Data Decoders (5-H1) if the Bells or Vibra Harp voices are being played with Golden Harp. The data through IC1F (14-A2) passes through IC26A (14-A4) to data Collector IC30 pin 1 (13-All) where it routed to the upper decoder circuits (3-A7) and keys the appropriate audio signal. The number of scans the microprocessor outputs each note in the sequence is determined by rhythm speed and harp speed pushbuttons. Only data from the first scan of each new note in the sequence is allowed to pass to the Strike Tone Data Position Register IC33 (14-C5). This prevents repetitive strike tones from occurring as the Golden Harp note decays. This is accomplished by the Golden Harp Strike Tone Data Latch IC29A&B (14-D2). The first time a Golden Harp data bit is present, it trips Flip-Flop IC29 and pin 4 goes low. This low is transferred to the output of IC25 (14-C3) and disables the Golden Harp input to IC27 (14-C4). Before the microprocessor outputs the next note in the Golden Harp sequence, there will be a pre-determined number of scans where no data appears. This will allow IC29 (14-C2) to reset, which enables IC27 to except data for the first scan that the new Golden Harp note appears. The length of the Golden Harp note is determined by the time constant at pin 2 of IC26 (14-A3) which discharges when the output of IC25A pin 2 (14-C3) goes low. Turning on the Orchestral button of the Golden Harp section causes the enable input (14-A1) to go low and at the same time, pin 6 of IC31 (14-D11) switches high and allows the Golden Harp data to pass to Orchestral Symphonizer Decoders (22-H2) giving the Golden Harp effect to all voices in the Orchestral Symphonizer section.

CIRCUIT DESCRIPTION

AOC DATA

The AOC data is produced by the microprocessor IC1 (15-A2) and is dependent on lower keyboard keydown information. The AOC data is input through Buffer IC1F (14-A2) to AND gate IC28D (14-B4) and enters the 12 bit recirculating register IC34 (14-B5). This data is actually lower keyboard keydown information without an octave relationship. Holding down one lower keyboard key will produce one data bit input to register IC34 (14-B5). If Magic Chord is on, the processor calculates the chord from the lower keyboard keydown data and inputs the chord data to register IC34 (14-B5). The output of IC34 for AOC is taken from pin 11 and routed to the input of IC37A (13-H10). Playing an upper keyboard key routes a data pulse through IC37C (13-G7) and loads registers IC39-IC41 with a specific bit pattern. With AOC Organ on, the bit pattern starting at pin 7 of IC39 is 00000000 00001111 11111100. With AOC Organ and AOC Open Harmony on, the bit pattern for the three registers is 00000001 11110111 11100000. These bit patterns are clocked through IC39-IC41 and applied to pin 8 of IC37 (14-H10) allowing the circulating data at pin 2 of IC37A to pass when the bit pattern is at a high level. The upper keyboard data bit acts as the load pulse for the registers. The octave of the AOC data will follow the octave of the upper keyboard note being played and the data coupled will always be below the upper keyboard (melody) note. The load pulse also causes a one time point delay, so with AOC Organ on three time points after the load pulse occurs a series of nine ones appear at pin 8 of IC37A (13-H10) allowing the circulating data to pass. The three time point delay blocks notes that are within 3 notes of the upper keyboard note being played. For example, if a C note is played on the upper keyboard, the AOC window would open to let AOC data pass from A down through C# (played on the lower keyboard). See AOC Window Generator Timing Diagram.

With Open Harmony and AOC Organ on, there is a 6 time point delay before data is allowed to pass. For example, if a C note is played on the upper keyboard, the AOC Open Harmony window would open to let AOC data pass from F# down through G (played on the lower keyboard). The C note an octave below the C note being played is blanked from the scan. See AOC Window Generator timing diagram. All AOC data is then routed through IC30 (13-H11) to the upper keyboard decoders where the appropriate audio signals are keyed. Turning on AOC Symphonic adds the AOC data to the Orchestral Symphonizer data stream allowing all voices of the Orchestral Symphonizer to have an AOC effect.

LOWER KEYBOARD DATA

The path for lower keyboard data when Magic Memory and Magic Chord are off is through pin 9 of data collector IC14 (14-G11) to the lower keyboard decoders (9-H4) and is used to key the Flute and R/S voices of the lower keyboard. Turning the Orchestral Lower pushbutton (in the Custom Symphonizer section) allows the lower keyboard data to pass to the Orchestral Symphonizer Decoders (22-H2) through pin 8 of IC31 (14-D11). This makes it possible to play the Orchestral Symphonizer voices from the lower keyboard. With Orchestral Lower on, pin 2 of IC31 (14-C8) goes low and disables upper keyboard data from reaching the Orchestral Symphonizer Decoders. Since there is no 12 bit delay in the lower keyboard data path as there is in the upper, the Orchestral Symphonizer voices will play at an 8-foot pitch when keyed from the lower keyboard.

MAGIC MEMORY DATA

Data for Magic Memory is routed through IC10D (14-G7) to the lower keyboard data collector IC14 (14-G11). If the Magic Memory tabswitch is on, this data passes to the lower keyboard decoders (9-H4) and keys the lower keyboard Flute and R/S voices. The data through IC10D (14-G7) is also routed into recirculating register IC8 (14-G8). Any keydown data produced by the scan is continually circulated through IC8 and through pin 12 of IC10 to the lower decoder circuits. This causes any keys pressed to continue to play after being released. This circuit will not recognize a key up and the data in Register IC8 is only updated if a new keydown is detected. This is accomplished as follows: Data from the previous scan is stored in IC16 (14-H3), the inverse of this data is clocked out and compared to data of the current scan by IC15C (14-H5). If a new keydown has occurred, a positive pulse is generated at the output of IC15C at the time point of the new keydown. This pulse is latched at the output of IC12E (14-H6). At time point 64 it is routed through IC10B to pin 10 of IC8. This blocks the circulation of data and clears register IC8. At the end of the next scan pin 1 of IC11A goes low and the new keydown data is allowed to enter IC8 at pin 15 where it will circulate until another new keydown is detected. If keyswitch bounce occurs, a

CIRCUIT DESCRIPTION

positive pulse is generated through IC3A and IC12F charging the capacitor at pin 4 of IC11. This holds IC11A in a reset mode until the time constant at pin 4 discharges. This blocks data from passing until the keyswitch contact stabilizes.

MAGIC CHORD DATA

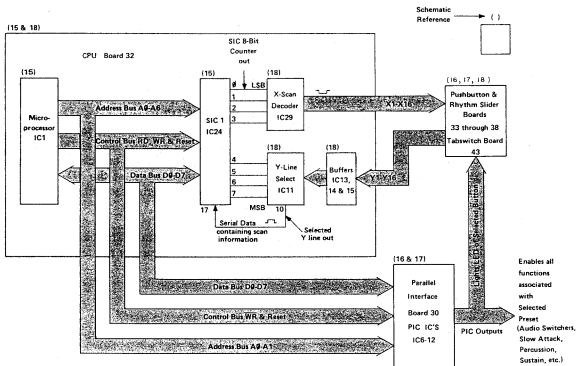
Lower keydown data is routed through IC10A and Q1 (14-F7) to the SIC IC25 (15-G7). The microprocessor takes this data in from the SIC and calculates the chord that is to play. The chord data (AOC data) is then routed through the SIC to the input of Buffer IC1F (14-A2) and then enters the recirculating shift Register IC34 (14-B5) through gate IC28D and IC36C (14-B4). The keydown data from the scan is also routed through IC10C (14-F8) and triggers the Magic Chord Octave Position Flip-Flop IC9A&B. Pin 4 of the Flip-Flop goes low and pin 3 goes high and enables gate IC37B (14-F10). Since pin 4 of the Flip-Flop was previously high, there are 12 ones stored in shift register IC6. These 12 ones are shifted through register IC6 to pin 4 of IC37B generating a 12 bit window and allowing chord data from IC32A pin 2 (14-A6) to pass through IC37B. Since the note being played generates this window, the chord data will play in the octave of the played note. If the key is being played in the lowest octave, the chord window is generated at time point 37 through pin 8 of IC10C and the chord is automatically positioned in the lowest octave. Turning on the Magic Chord tabswitch allows this data to pass to the lower keyboard decoder circuits (9-H4) keying the lower keyboard voices.

PEDAL SERIAL DATA

The pedal serial data is routed through IC10A (14-F7) and Q1 to the SIC IC25 (15-G7). The microprocessor IC1 (15-A2) accesses this data to determine what pedal has been played. It then programs IC29 (19-B6) Programmable Oscillator on Orchestration Plus Board 25B. IC29 then outputs the appropriate 8-foot pedal signal at pin 21 (Freq. 4). This signal is routed to the pedal filtering circuits (12-C5) where the tonal quality for all pedal tabswitch voices is produced. The voices of the symphonic bass section (piano, bass fiddle and tuba) are produced by the voice 6 channel in Orchestration Plus circuit (21-E10) Board 25B. The pedals are inoperative if an Orchestration Plus style is being used.

CIRCUIT DESCRIPTION

PUSHBUTTON SCANNING SYSTEM



PUSHBUTTON SCANNING SYSTEM

[Schematics 15 & 18]

Scanning of the pushbuttons is controlled by Serial Interface Controller 1 (SIC) IC24 (15-G5). The SIC1 8 bit counter is output on pins 9-16. The 4 least significant bits (LSB) are routed to the X Scan Decoder IC29 (18-G2) and the 4 most significant bits (MSB) are routed to the Y Line Select Multiplexer IC11 (18-A11). For each count of the counter, Decoder IC29 sequentially puts out a negative pulse on the X1 through X16 lines. After each sixteen counts of the counter the Y Line Select IC11 (18-A11) is advanced, allowing the next Y Line to receive 16 X Scans. A switch closure will produce a negative data pulse at the input of the Y Line Selector. Each switch has a unique coordinate in the scan. For example, turning on the Ballad Rhythm button (18-D1) produces at negative pulse at pin 3 of IC11 (18-A11) at coordinates X9-Y6. All data input to the Y Line Selector is inverted and multiplexed into a single serial data stream which is output at pin 10. The data is routed to SIC1 IC24 (15-G5) where it is stored. The microprocessor IC1 (15-B2) takes in this data from SIC1 and determines what switch or switches are active, then writes to the appropriate pin of a Parallel Interface Controller (PIC) IC on the parallel interface board, lighting the LED of the selected pushbutton (Schematic 16 & 17). Other PIC outputs may also be addressed, enabling audio switches, sustain length, envelope generation or any other functions associated with the selected voice. For example, selecting the chimes voice (18-G11) produces a data bit at X4-Y2 time point. The microprocessor addresses PIC IC6 (16-A1) and switches pin 38 of this IC high lighting the chimes LED through inverter IC18 (16-B5). Pins 29 & 32 are also switched high, cancelling voltage to the upper tabs (4-G1) and enabling the chimes preset sustain (3-E7). In addition, pins 30 and 31 are switched low, cancelling all other upper keyboard voices (13-C1) and enabling the Chimes Data Generator IC39-IC41 (13-H2). Selecting any pushbutton causes a similar sequence of events to occur. The schematics have notes and truth tables identifying when a function is active. Active low inputs and outputs are identified with a bar over their function.

DIGITAL RHYTHM DISPLAY

[Schematics 17 & 18]

The 24 position Rhythm Slider switch (18-G7) is scanned as the pushbuttons are. The slider puts

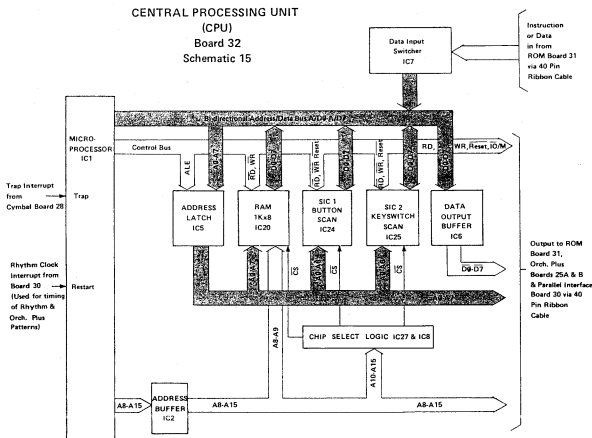
CIRCUIT DESCRIPTION

out a binary code indicating the position of the slider. This information is routed to the SICI IC24 (15-G5) where it is stored. The microprocessor IC1 (15-B2) accesses this information and determines the values to be written to the Seven Segment Display Decoder Drivers IC36-38 (17-A3). The binary output from the microprocessor that is applied to IC36-38 causes the appropriate decoder outputs to go high, lighting the segments of the display that produce the decimal equivalent of the binary input.

From the position of the rhythm slider the microprocessor also determines the frequency of the Restart Interrupt on pin 7 (15-E2). The divider value to produce this frequency is written into the Clock 1 divider of the Programmable Oscillator Peripheral (POP) IC2 (17-B11) and the 4MHz clock input on pin 23 of IC2 is divided by this value. The clock 1 output on pin 19 is used to trigger the discharge circuit for the Orchestration Plus Glide circuit. This frequency is also used as the clock 2 input of the POP on pin 24 (17-C11). The ratio between clock 2 input on pin 24 and clock 2 output on pin 20 is always divided by 128, this ratio is established on initialization of the POP IC and remains constant. The clock 2 output on pin 20 is then routed to the microprocessor interrupt input and is used to time the Rhythm and Orchestration Plus outputs.

The only other output of IC2 (17-B11) that is used is the clock 4 output on pin 4. This clock output is programmed on initialization of IC2 to be a 33KHz frequency. This frequency remains constant and is used as the clock frequency for the Cymbal counters (29-E2).

CIRCUIT DESCRIPTION



CENTRAL PROCESSING UNIT [Schematics 15 & 18]

The Central Processing unit of the MX1 consists of an Intel 8085 microprocessor, fifteen 4K x 8 bit ROMs (Read Only Memory), two SIC chips (Serial Interface Controllers), a 1K x 8 bit RAM (Random Access Memory), various tri-state buffers and an address latch.

THE 8085 MICROPROCESSOR

AD0-AD7 (Pins 12-19)

These lines are a multiplexed address/data bus used for output of the lower 8 bits of memory address during the first clock cycle of each machine cycle. For the remaining machine states the bus becomes a bidirectional data bus. Since this is a multipurpose bus and address only appears for part of a machine cycle, an address latch chip IC5 (15-F4) is needed to hold the address for the entire machine cycle. This bus is tri-stated during hold and halt modes.

A8-A15 [Pins 21-28]

The 8 most significant bits of memory address are held on the line for the entire machine cycle and do not require an external latch IC. These outputs are tri-state during hold and halt modes.

IO/ $\overline{M}$ [Pin 34]

The input output/memory indicates whether the microprocessor is accessing a memory device or an input output device. For example, if this line is low the microprocessor would be accessing a memory location in ROM, or RAM or one of the SIC chips. When this line is high, the microprocessor would be accessing an input output device such as one of the PIC chips on the Parallel Interface Board (Schematic 16 & 17) or the Orchestration Plus Boards (Schematics 19-21). This output is tri-state during hold and halt modes.

CIRCUIT DESCRIPTION

ALE [Pin 30]

Address Latch Enable goes high at the beginning of each machine cycle and latches the lower 8 bits of address AD $\bar{0}$ -A7 into the Address Latch Chip IC5 (15-F4). The ALE line is never tri-stated.

INTA [Pin 11]

Interrupt Acknowledge, if an interrupt request is issued on the INTR input pin 10, pin 11 goes low to indicate the interrupt has been accepted. Not used in the MX1 system.

READ [Pin 32]

The Read Line is lowered when data from a selected memory device is being input to the microprocessor. The lowering of this line indicates that the Data Bus D $\bar{0}$ -D7 is available for a data transfer. This output is tristate during hold and halt modes.

WRITE [Pin 31]

The Write line is lowered when data from the microprocessor is being output to a selected memory device. The lowering of this line indicates that the Data Bus D $\bar{0}$ -D7 is available for a data transfer. This output is tristate during hold and halt modes.

RESET OUT [Pin 3]

This output goes high whenever Reset IN, pin 36 goes low. It is used to reset all other chips in the system.

CLOCK [Pin 37]

The clock output is used as the system clock. It is one half the crystal frequency or 3MHz.

RESET [Pin 36]

This input is held low during power on and resets the microprocessor program counter to zero.

READY [Pin 35]

If this input line is low it adds wait states to the machine cycle making it compatible with slower peripheral devices. Not used in the MX1 system.

HOLD [Pin 39]

If this input line is high the microprocessor tristates the Address, Data, Read, Write and IO/ $\bar{M}$ lines and relinquishes control to the requesting device. Not used in the MX1 system.

HLDA [Pin 38]

The Hold Acknowledge output goes high to indicate that the microprocessor has received a hold request on pin 39 and that it will relinquish control of the busses on the next clock cycle. Not used in the MX1 system.

SERIAL INPUT DATA [Pin 5]

This input is under software control. Data on this line is loaded into bit 7 of the microprocessor's accumulator register whenever a specific instruction is being executed. This input not used in the MX1 system.

SERIAL OUTPUT DATA [Pin 4]

This output is under software control. Data in bit 7 of the microprocessor's accumulator register is output on this line whenever a specific instruction is being executed. This output not used in the MX1 system.

SO, SI [Pins 29 and 33]

These two outputs give an encoded status of the machine cycle that is being performed.

CIRCUIT DESCRIPTION

<u>S1</u>	<u>S0</u>	
0	0	Halt
0	1	Write
1	0	Read
1	1	Fetch

These outputs not used in the MX1 system, but status information is still available on these lines.

INTERRUPTS

The 8085 microprocessor is equipped with five interrupt lines. Two of these lines are used in the MX1 system. The TRAP interrupt on pin 6, and the priority 2 Restart interrupt on pin 7. The TRAP interrupt has the highest priority and is used to signal the microprocessor that the cymbal comparator (29-F3) value needs to be updated. When the TRAP interrupt input goes high, the microprocessor finishes the current instruction it is executing and then is vectored to a routine to service the cymbal circuit. After completion of this routine, the microprocessor refers to the position in program before interrupt occurred and continues executing instructions from there. The priority 2 Restart interrupt on pin 7 is used to time Rhythm and Orchestration Plus outputs. The frequency of this interrupt varies with the position of the Rhythm Speed Control. The microprocessor keeps track of the number of interrupts that have occurred and determines when a Rhythm or Orchestration Plus output is required. If an output is required, the microprocessor vectors to a routine to service the Rhythm or Orchestration Plus circuits. The priority of an interrupt indicates in which order the microprocessor will recognize and service interrupts.

ROM [Read Only Memory] IC1-IC15

The 15 - 4K x 8 bit ROMs serve as a place to store the instructions that direct the activities of the microprocessor. The group of instructions stored in ROM is referred to as a program. The microprocessor "reads" each instruction from memory in a logically pre-determined sequence and initiates processing actions. ROM is also used to store the data to be manipulated as well as the instructions that direct the manipulation. The program is organized so that the microprocessor does not read a non-instruction word when it expects to see an instruction. The four most significant bits of Address A12-A15 are routed to a ROM Select Decoder IC17 (15-C8) which enables one of the 15 ROMs. The A θ -A11 address lines select a location in the enabled ROM. The microprocessor outputs this address and then issues a read pulse enabling input Switcher Buffers IC19 (15-B10) and IC7 (15-B7). The data or instruction from the selected ROM location is then input via the data bus into the microprocessor for processing.

RAM [Random Access or Read/Write Memory] IC20

The microprocessor uses the 1K x 8 bit RAM to store data that it can retrieve for use at a later time. For example, assume the microprocessor has a value in its Accumulator Registers that it wishes to save. The following sequence of events will store this value in a RAM location.

1. The contents of the program counter appears on the A θ -A15 address lines, an ALE pulse is generated latching the A θ -A7 address bits. The IO/M and the Read Line are lowered indicating a Memory Access cycle. The selected ROM location returns the addressed byte; in this case it would be the Store Accumulator Instruction.
2. The microprocessor decodes this instruction and then outputs the RAM address on the A θ -A15 address lines. The A8-A15 address lines are used to enable the chip select input of RAM through IC8 (15-D5). The A θ -A7 address lines are latched by ALE and address the specific RAM location where the data is to be stored.
3. The microprocessor now outputs the contents of the Accumulator register on the D θ -D7 Data Bus, and generates a Write pulse. This latches the Accumulator value into the addressed RAM location.

If this value needs to be accessed at some later time, a similar sequence of events occurs. The difference being that instead of a Store Accumulator Instruction, the microprocessor would read a Load Accumulator Instruction and would generate a Read from RAM.

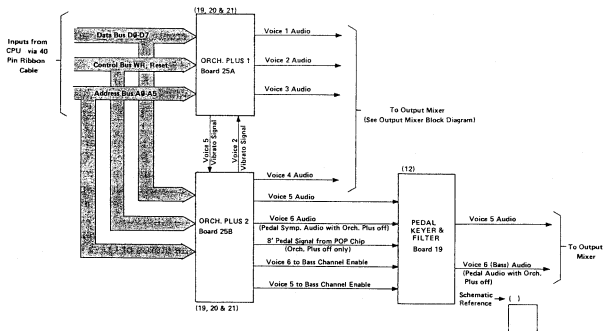
CIRCUIT DESCRIPTION

SIC [Serial Interface Controller] IC24 and IC25

The SIC ICs control the pushbutton and keyboard scanning systems. Data pertaining to active pushbuttons is input to IC24 and active key data is input to IC25. The microprocessor polls these two chips each cycle through the program loop. If data has changed from one scan to the next, the internal status register of the SIC chip indicates a change has occurred. The microprocessor then searches the SIC's internal RAM to "see" what data has changed. The new data is then processed to update pushbuttons and chord selections. IC25 is programmed by the microprocessor to output a 25KHz clock (used as the scan clock) and various strobes and timing pulses used by the keyboard encoder circuit. Chord and AOC data, which is calculated by the microprocessor from data obtained in scan, is output from the microprocessor through SIC chip IC25 where it is serialized and routed to the keyboard encoder circuit.

CIRCUIT DESCRIPTION

ORCHESTRATION PLUS & PEDAL SYSTEM (Affects Orchestration Plus & Performance Effect Pushbutton Sections and all Pedal Tabswitch & Pedal Symphonizer Voices.)



ORCHESTRATION PLUS & PEDAL SYSTEM [Schematics 12, 19, 20 & 21]

There are six voice channels that produce the Orchestration Plus styles, three channels on each of the two Orchestration Plus boards. The schematics on Dwg. 19, 20 & 21 show the circuitry contained on one of the two boards. The voice channels shown in parenthesis indicate the equivalent channel on the second Orchestration Plus board. Any differences between the two boards, such as input and output designations, are noted on the schematics.

ORCHESTRATION PLUS TONE GENERATOR

There are three 2MHz oscillators on each of the two Orchestration Plus Boards Q20-22 (19-D5) which create the audio frequency source for the six Orchestration Plus voice channels. To produce the correct frequency for each of the channels, the microprocessor writes divider values into the five programmable dividers of the Programmable Oscillator Peripheral IC29 (19-A6). The 2MHz inputs are divided by these values and a square wave audio signal is produced on Pins 21, 4 and 5 of IC29. The microprocessor determines the divider values from information obtained in the scan. It then selects one of the Orchestration Plus boards by enabling IC4 (19-E1). The A2-A5 address inputs to IC4 select the IC on that board which the microprocessor wishes to access. If IC29 (19-A6) was the selected IC, Pin 10 of IC4 would switch low. This low level is applied to Pin 2 of IC46A (19-A4). A write pulse occurring at this time would cause Pin 18 of IC29 to go low and the value on the D0-D7 lines to IC29 would be latched into a selected divider. The microprocessor also programs the frequency of the outputs on Pin 19 & 20 of IC29 in the same manner. These outputs are routed to the filter circuit where they tune the filters to a specific frequency range.

Two voice channels on each board can have a vibrato effect. If vibrato is called for in the Orchestration Plus style the microprocessor selects IC20 (19-D2) and writes Pin 13 (19-E2) of this IC high. This turns on Vibrato Enable Switchers IC5C&D (15-G3) and allows the output of the Vibrato Oscillator to vary the frequency of 2MHz oscillators Q20 & 21 giving these channels a vibrato effect. It should be noted that the output of the Vibrato Oscillator on each of the Orchestration Plus boards drives one voice channel on each board. For example the vibrato oscillator on board 25A drives the 2MHz

CIRCUIT DESCRIPTION

oscillator for Voice Channel 1 on board 25A and Voice 5 on board 25B. This is noted on the schematic by the designation "other Orch. Plus Board" at S4-4 (19-G3) and S4-5 (19-H3) there is no schematic reference given for this input or output since the schematic shown is for both Orch. Plus boards.

Each of the Orch. Plus voice channels is capable of having a glide effect. The glide effect is produced by charging, then discharging, the 5.6 uf capacitor in the base circuit of each oscillator, momentarily shifting the oscillator frequency. The rate at which this cycle occurs is varied by changing the charge and discharge times of the 5.6 uf capacitor. To create the glide effect, the microprocessor enables IC20 (19-D2) and then writes a value into IC20 that will turn on some combination of Q23 & Q24 (19-B3). This sets the collector voltage of Q14 and controls the charging current available through Q14, thereby controlling the rate at which the 5.6 uf capacitor will charge. Once this collector voltage is selected, Q14 is turned on by applying a positive voltage to its base. This turns Q14 on applying a positive voltage to the emitters of Q11, 12 & 13 (19-3C, D & E). Depending on the channel or channels to be glided, one or more of these transistors is turned on, allowing the 5.6 uf capacitor to charge. As this capacitor charges it shifts the master oscillator frequency. Once the frequency has shifted the required amount, the Enable Switcher (Q11, 12 or 13) turns off allowing the capacitor to discharge onto the Glide Discharge line which returns the master oscillator to its normal operating frequency. The discharge rate of the capacitor is controlled by Q7, 8, 9, 10 & IC3. IC3 (19-F1) is a one shot multivibrator that is triggered at Pin 5 by a frequency which is variable with the Rhythm Speed. Each time IC3 is triggered, a positive pulse appears at its output, Pin 6. The pulse produced at Pin 6 is a waveform that is the frequency of the trigger input at Pin 5 with a duty cycle that is variable depending on the states of Q7 & Q8. If the positive cycle of this frequency is long in comparison to the negative cycle then Q9 & Q10 (19-F2) will be on for most of the cycle which reverse biases diodes D61, 62 & 63 and prevents the 5.6 uf capacitor from discharging during this period, thereby creating a long discharge time. Therefore, the discharge time can be altered by changing the duty cycle or the frequency of the IC3 output.

The glide rate, frequency shift and timing are all predetermined in the systems program and are dependent on the Orch. Plus style and chord being played.

ORCHESTRATION PLUS KEYER

There are three identical keyer circuits on each of the Orchestration Plus boards. One keyer is shown on Dwg. 19, the other two are shown on Dwg. 20. For description purposes, the references for the keyer circuit on Dwg. 19 are used.

The keyer circuits produce and select the audio signal waveform as well as producing the keying envelope. The square wave audio output of IC29 pin 21 (19-B6) is routed to Pin 13 of IC38 (19-C9). If the instrument being played in this channel calls for a square wave audio signal, Pin 11 of IC38 is switched high and Pin 11 of IC30 (19-C10) switches low allowing the square wave audio to pass to the base of Q39. The square wave audio signal is also used to trigger Flip-Flop IC18 (19-B9). IC18, 26, 43 and 44 comprise a variable pulse width generator circuit, capable of producing pulse audio waveforms with duty cycles ranging from 3% to 33%. The microprocessor, through IC42 (19-E7) applies a binary code to IC44 (19-B8) which selects one of the resistors at IC44's input. This causes the output of IC26A Pin 1 (19-A9) to rise to a positive level which is dependent on the resistor ratio chosen. The .33 uf capacitor at Pin 5 of comparator IC43B (19-A10) charges to this level. When IC18A Pin 1 (19-C9) is triggered, its output Pin 3 goes high and charges the .33 uf capacitor at Pin 6 of IC43B (19-A9). When the charge on this capacitor is equal to the charge on the capacitor at Pin 5 of IC43B the output of IC43B goes low. This low is transferred through IC43A and resets IC18. As can be seen from the above description, Pin 3 of IC18 will remain high until the inputs of IC43B are equal, by simply changing the reference voltage on Pin 5 of IC43 (by selecting different resistor values through IC44) we can control the length of time that the output of IC18 remains high thereby controlling the duty cycle of the pulse wave audio signal output at Pin 3 of IC18. If the pulse wave audio signal is called for, Pin 11 of IC38 and IC30 (19-C9) is switched low allowing the audio signal to pass to the base of Q39. The pulse wave audio is also applied to the base of Q37 (19-C9). Q37 & Q38 transform the pulse wave audio signal into a sawtooth audio signal. If the voice playing calls for a sawtooth waveform, Pin 11 of IC30 is switched high allowing this audio signal to pass to the base of Q39. The chosen audio signal is then routed through the Audio Attenuator circuit where it is amplitude adjusted before being routed to the filtering circuits.

CIRCUIT DESCRIPTION

KEYING ENVELOPE GENERATOR [Dwg. 19]

The shape of the keying envelope is controlled by the combination of attack, decay and percussive snub resistors that is selected for a given voice.

When an orchestration plus note is to be played, the attack enable output of IC8 (Dwg. 21) switches high, applying +15VDC through the selected attack resistor to the base of the keying envelope generator. The attack time is the resistor-capacitor (RC) time constant formed by the selected resistor and the 1 μ f capacitor at the base of the keying envelope generator. As the capacitor charges, Q33 (19-E9) turns on applying a positive going voltage to the audio modulator driver (Dwg. 21), the modulation range selector (Dwg. 21) and the decay start detector (19-E10). When the emitter of the keying envelope generator exceeds +12VDC the output of the decay start detector switches low. The microprocessor checks the status of the six decay start detectors (15-B11). When a decay is to begin, the microprocessor turns off the attack enable and switches the decay or percussive snub enables low, providing a discharge path for the 1 μ f capacitor.

ORCHESTRATION PLUS FILTERS [Dwg. 21]

The audio waveform is amplified by the filter input preamp (21-E3) and applied to the first voltage controlled filter. The voltage controlled filters are tuned by the width of the pulses applied to the gate inputs of the switchers. The switchers act like variable resistors. The "resistor"-capacitor (RC) combination determines the resonant frequency of the filter. As the effective value of the "resistor" changes, the tuning of the filter changes. The pulse width and pulse frequency are selected by the microprocessor and are determined by the voice and frequency to be played. The pulse width is modulated by the filter envelope (from keying envelope generator). Voice 1 and Voice 4 each have a filter which can be switched into the circuit to create the banjo voice.

The output of each filter is applied to an audio modulator which is controlled by the keying envelope. The signal output for Voices 1 through 4 are applied to the output mixer. Voices 5 and 6 are routed to the Pedal Keyer and Filter Board where either Voice 5 or Voice 6 is switched into the Bass Mixing Preamp.

BASS QUALITY CONTROL [Dwg. 12]

When Orchestration Plus is off, Voice 4 (IC29 Pin 21, Board 25B) (19-C6) provides the audio frequency for the bass pedals and keyboard bass. The signal is applied to the pedal audio buffer (12-C5) and the pedal frequency divider (12-D5). When a bass note is keyed, the rhythm PIC (Dwg. 28) applies a positive keying voltage to the Pedal Keydown Driver Q3 (12-B3). If a bass tab is on, Q3 turns on applying positive voltage to keyer drivers Q7 (12-B4), Q15 (12-F4), Q4 (12-G4) and Q11 (12-D6). The voltage applied to Q4 is developed into a pulse for the guitar bass. The envelope output from each keyer driver forward biases a keying diode enabling audio signal to be applied to a filter where it is voiced. A switcher at the output of each filter enables the bass audio to pass to the Bass Mixing Preamp IC4D (12-C11). The double bass (pedal string) audio is applied to the three channel chorus modulator via the mixer. (See Dwg. 30.)

The Symphonic Bass Piano, Bass Fiddle and Tuba presets are developed by Voice 6 of the Orchestration Plus. This signal is routed through Q2 Voice 6 to Bass Switcher (12-B10) to the Bass Mixing Preamp IC4 (12-C11).

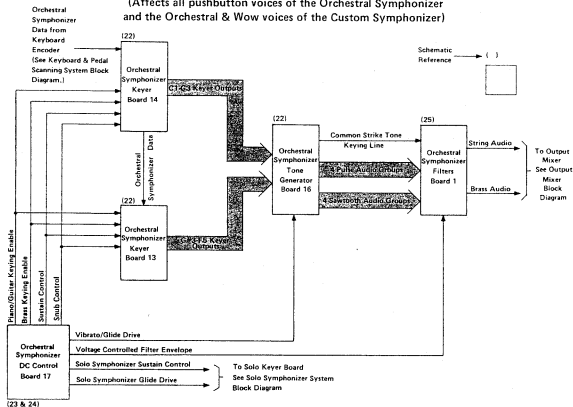
When the Orchestration Plus is being played, the pedal keydown voltage is grounded through Q30 (12-B2). The bass audio is developed by Voice 6. Voice 5 is used for some Orch. Plus patterns. (See Orchestration Plus Chart.) The voice with the bass audio is routed to the Bass Mixing Preamp. The other voice is routed to the output mixer (Dwg. 30) after being amplified by Orch. Plus Voice 5 Preamp (12-A11).

The signal output from the Bass Mixing Preamp is attenuated by the Bass Volume Switchers then applied to IC4A Bass Preamp. The output of the bass preamp is applied to the mixer. (See Dwg. 30.)

CIRCUIT DESCRIPTION

ORCHESTRAL SYMPHONIZER SYSTEM

(Affects all pushbutton voices of the Orchestral Symphonizer and the Orchestral & Wow voices of the Custom Symphonizer)



ORCHESTRAL SYMPHONIZER SYSTEM

ORCH. SYMP. KEYING [Schematic 22]

Upper keyboard serial data (Lower keyboard data when Orch. to Lower coupler is on) is shifted serially into Serial to Parallel Decoder Latches IC1 (Board 14) and IC1 (Board 13). When data has shifted into the latches and is properly aligned, a strobe pulse occurs latching the data. Had keys been pressed, the corresponding outputs of the Decoder Latch would switch high. The logic level converters increase this voltage (depending on the orchestral symphonizer preset selected) and apply it to the Orch. Symp. Keyer Driver (22-E6). The input to the keyer driver may be either a pulse (piano/guitar) or a steady voltage (brass) depending on the preset selected. The keyer voltage is applied to the Pulse Keyer and Sawtooth Keyer (22-B8).

ORCH. SYMP. TONE GENERATOR [Schematic 22]

The Orch. Symp. Master Oscillator Q63 (22-F9) applies four megahertz to a divider. The two megahertz output of the divider is applied to a top octave synthesizer which generates an octave of audio frequencies. Each TOS frequency is applied to a divider to create the lower frequencies required by the Orchestral Symphonizer.

The outputs of the dividers are applied to the sawtooth and pulse keyers. When an Orch. Symp. note is keyed, the audio signal passes via the pulse keyer groups and sawtooth keyer groups to the Pulse Keyer Filters (25-H1) and Sawtooth Filters (25-D1).

ORCH. SYMP. QUALITY CONTROL [Schematic 25]

The pulse keyer filters and sawtooth filters provide waveshaping before the audio is applied to the specific voicing filters. Each voicing filter develops the tonality for the specific voice. The switcher for the voice to be heard is enabled by a positive voltage applied to the gate input of the FET.

The string voices (except banjo) and the French Horn are phase modulated by the chorus modulator. The phase modulated audio is applied to the String and Brass Volume Regulators. The outputs of the volume regulators are routed to the Output Mixer.

The Voltage Controlled Filter (25-B2) has a voltage envelope applied to it. As the voltage changes, the harmonic content of the audio signal changes creating the tonality of the selected voice.

CIRCUIT DESCRIPTION

ORCH. SYMP. DC CONTROL [Schematic 23]

The Tremolo/Vibrato Oscillator provides a low frequency signal to modulate the orch. symp. keying voltage (tremolo) and the Orch. Symp. Master Oscillator (vibrato) 22-G9. At the first keydown the delay trigger 23-A2 momentarily disables the tremolo/vibrato oscillator.

The Orch. Symp. Driver Q14 (23-B11) applies positive voltage to the Logic Level Converters (Dwg. 22). Some of the presets use a low keying voltage which is enabled by turning on Q13 (23-B10).

The switching control for the transistors is provided by Parallel Interface Controllers (PIC). The selected orchestral preset determines which of the switchers is enabled or disabled for glide, sustain length, tremolo, repeat and guitar snub. The enables for solo glide and sustain are located on this board.

ORCH. SYMP. FILTER ENVELOPE [Schematic 24]

The circuitry shown on Schematic 24 provides an envelope which is used to control a voltage controlled filter (25-B2) for the Orch. Trumpet, Wow, Brass Ensemble, and Orchestral Custom presets.

When either the trumpet, brass ensemble, wow or custom preset is selected, the appropriate set of attack, range, tuning, decay and sustain switchers is selected. The brass keying line is selected.

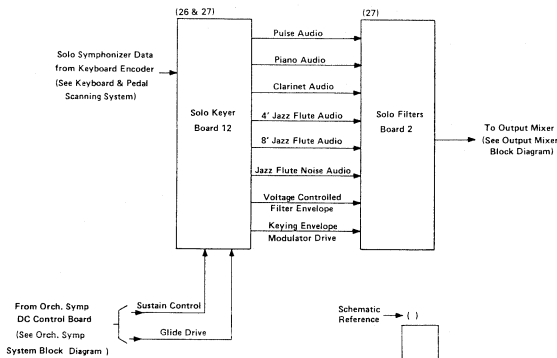
Any keydown will cause the Filter Envelope Trigger (24-D2) to output a pulse. This pulse resets the Set-Reset Flip-Flop (24-E4), discharges the .68 uf capacitor at the base of Q6 (24-D5) and turns off Envelope Generator Q5 (24-D5). At the conclusion of the trigger pulse, Q5 turns on causing the .68 uf capacitor to charge at a rate determined by the selected attack resistor. The positive going ramp is applied through a range resistor to the Initial Frequency Preamp (24-C7). The signal gain (less than one) is determined by the range resistor. The filter tuning preamp (24-D8) further amplifies the signal. The signal is attenuated through the octave select decoder (24-E10). [See chart on Schematic 24 to see which resistor is selected in any octave.] and applied through a voltage follower and the filter tuning driver to the Voltage Controlled Filter (25-B2).

The maximum level output from Q6 is determined by the voltage divider at pin 6 of Comparator IC9B (24-F5). When the level at pin 5 exceeds the reference level, the output of the comparator (pin 7) switches high, which sets pin 4 of IC7B (24-F4) high. The decay envelope switcher turns on and the .68 uf capacitor begins to discharge at a rate determined by the decay resistor and sustain resistor.

CIRCUIT DESCRIPTION

SOLO SYMPHONIZER SYSTEM

(Affects all Solo Symphonizer Voices &
Solo Voice of the Custom Symphonizer.)



SOLO SYMPHONIZER SYSTEM

TONE GENERATION [Dwg. 26]

The Solo Symphonizer employs a Solo Note Generator to develop the audio frequencies, keydown voltage and octave selection data. The solo master oscillator (26-B5) applies four megahertz to a divider. The one megahertz output is applied to the solo note generator where internal circuitry divides the frequency to provide the audio output. The solo master oscillator frequency is modulated by the Solo Vibrato/Tremolo Oscillator (26-A3) giving a vibrato effect when the tremolo depth is increased.

The keyboard encoder (Dwgs. 13 and 14) provides the clock, strobe and upper keyboard data to the solo note generator. The solo note generator outputs only the highest note being played on the upper keyboard at 4-, 8- and 16-foot pitches. The 4- and 8-foot audio is used for the jazz flute preset. The 16-foot pitch is used for all other presets.

SOLO KEYING [Dwg. 26]

Pin 15 of IC30 (Solo Note Generator) switches high when a key is pressed. This applies keying voltage through the keyer delay to the drivers used to key the solo presets.

The keying voltage is developed into a pulse for use by the Percussion Driver. The decay length of the pulse is determined by the snub circuit that is selected.

The keying input to Pulse Driver IC29A (26-B12) is either the percussion envelope or the slow attack envelope. The output pulse width is determined by the amplitude of the percussion or slow attack pulse.

SOLO FILTER [Dwg. 27]

When a solo preset is selected, the keyed audio signal is routed to the selected filter to develop the tonality of the instrument. The voiced audio is applied to the Solo Audio Preamp IC25B (27-D12)

CIRCUIT DESCRIPTION

where the signal is amplified. The output of the preamp is applied via the Solo Volume Control to the Mixer.

The Filter Envelope Generator circuit shown on Schematic 27 provides an envelope which is used to control a voltage controlled filter (27-B11) for the Solo Trumpet, Trombone, Jazz Guitar and Solo Custom presets.

When either the trumpet, trombone, jazz guitar or custom preset is selected, the appropriate set of attack, range, tuning, decay and sustain switchers is selected. The pulse audio line is selected.

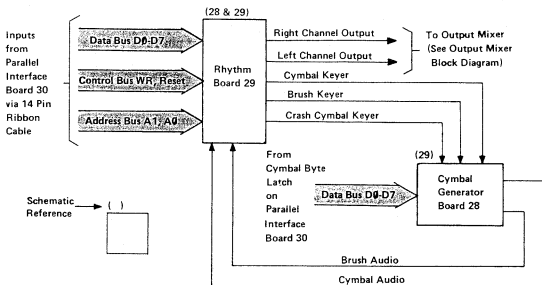
Any keydown will cause the Filter Envelope Trigger (27-D2) to output a pulse. This pulse resets the Set-Reset Flip-Flop (27-E3), discharges the .82 uf capacitor at pin 12 of Voltage Follower IC23 and turns off Envelope Generator Q22 (27-D4). At the conclusion of the trigger pulse, Q22 turns on causing the .82 uf capacitor to charge at a rate determined by the selected attack resistor. The positive going ramp is applied through a range resistor to the Initial Frequency Preamp (27-D5). The signal gain (less than one) is determined by the range resistor. The filter tuning preamp (27-D6) further amplifies the signal. The signal is attenuated through the pulse code filter and applied through the filter tuning driver to the Voltage Controlled Filter (27-B11).

The maximum level output from IC23B is determined by the voltage divider at pin 2 of Comparator IC23A (27-E4). When the level at pin 3 exceeds the reference level, the output of the comparator (Pin 1) switches high, which sets pin 4 of IC21B (27-E2) high. The decay envelope switcher turns on and the .82 uf capacitor begins to discharge at a rate determined by the decay resistors and sustain resistors.

CIRCUIT DESCRIPTION

RHYTHM SYSTEM

(Affects all Rhythm Patterns of the Stereo Digital Rhythm Button Section, also the Intro, Auto Start & Crash Cymbal Buttons of the Performance Effects Section.)



RHYTHM SYSTEM

[Schematics 28 & 29]

The position of the rhythm speed control (18-H7) is checked during the scan of the lighted button switches. The microprocessor determines the speed that the rhythm and orchestration plus is to play and programs a divider of Programmable Oscillator Peripheral (POP) IC2 (17-B11) to develop the proper rhythm clock frequency.

The rhythm clock is applied to an interrupt input of the microprocessor. When an orch. plus preset and/or rhythm is selected, the microprocessor counts rhythm clock pulses. When the processor determines that the orch. plus is to play or a rhythm beat is to be output, the processor extracts the data from tables located in read only memory (ROM) and writes this data to parallel interface controllers (PIC) located on the orch. plus and rhythm boards. (See Orchestration Plus System for information about the orch. plus.)

RHYTHM [Dwg. 28]

The outputs of the rhythm parallel interface controller (PIC) switch high (+15V) when selected. The Port 1 and Port 2 outputs of IC7 are applied through trigger circuits or capacitors to develop the outputs of the PIC into pulses which trigger the pulse generators into a ringing oscillation. This envelope creates the tonality of the rhythm instrument to be played. Port 0 controls sustain and snubs for several of the instruments.

The signals are collected and amplified by the left and right channel collector preamps. The output of the collector preamps is applied to the left and right channel mixers where it is combined with brush and cymbal audio. Balancing is accomplished at the input to the mixers. The mixer outputs are applied through the rhythm volume control to the output mixer (Dwg. 30).

BRUSH/CYMBAL GENERATOR [Dwg. 29]

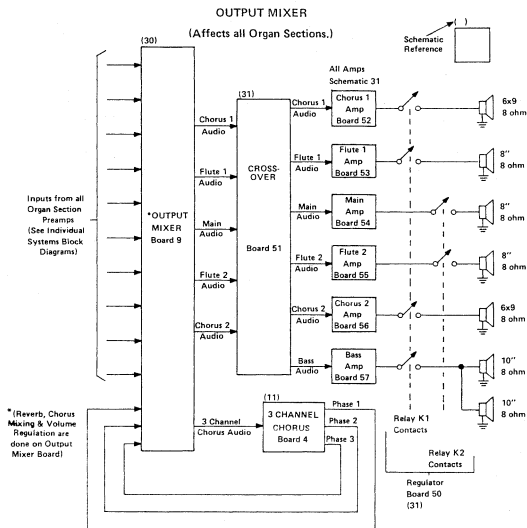
Read only memory (ROM) IC7 is a digital recording of a cymbal. The up/down counters address each ROM location at a rate of 33KHz from the cymbal clock. The output of the ROM is applied to a digital to analog converter which converts each byte of data into a DC voltage level. The DC level changes at such a fast rate that the sound of a cymbal is reconstructed. This signal is applied to the Cymbal and Brush Modulators. When a keyer pulse is applied to a modulator, the cymbal audio

CIRCUIT DESCRIPTION

passes through the modulator to the preamps (Dwg. 28).

The microprocessor (Dwg. 15) writes a number to IC4 Cymbal Byte Latch (17-H11). Bits 0 to 6 of this number are applied from IC4 to the "B-inputs" of Comparators IC5 and IC6. Bit 7 is applied to the Upcount/Downcount Switcher IC4A (29-H3). When the seven most significant bits (MSB) of the up/down counters equal the number from the cymbal byte latch, a positive pulse is output from IC5 Pin 6. This pulse will change the direction of the counter if bit 7 is high and clocks the Trap Enable Latch IC4B (29-H4). The output of IC4B applies a high to the TRAP interrupt of the microprocessor. The microprocessor completes the instruction being executed then vectors to the cymbal servicing subroutine. A new byte is latched into the cymbal byte latch and the trap enable latch is reset. The microprocessor returns to the main program and resumes operation from the point it was interrupted. The changing count, determined by the cymbal byte creates the shimmering sound of the cymbal.

CIRCUIT DESCRIPTION



OUTPUT MIXER

OUTPUT MIXER [Dwg. 30]

All audio signals created by the organ are applied to the output mixer. The signals are distributed to the five volume regulators through resistors which balance the sound.

All audio signals (except the chorus modulated flute and chorus modulated reed/string audio) are applied to the reverb circuit. A limiter (30-A7) controls the signal amplitude to reduce distortion through the reverb. The output of the reverb amplifier is distributed to the five volume regulators.

The volume regulators are controlled by the expression pedal. As the organ volume is increased, a shutter located between the photocell and lamp (30-H10) opens allowing more light to reach the photocell. The resistance of the photocell decreases as light intensity increases applying more voltage to the volume regulator driver which applies more voltage to the volume regulators, increasing volume.

The output amplifiers provide current gain for the audio signal. The audio signal is then applied to the crossover filters.

CROSSOVER [Dwg. 31]

Signals applied to the crossover board are applied to the chorus, flute and main high pass filters and to the bass low pass filter. Frequencies below 200Hz pass through the bass low pass filter to the bass amplifier. The Bass Channel Volume Regulator IC1 (31-G10) is controlled by the Volume Regulator Driver (30-H1).

AMPLIFIERS [Dwg. 31]

The amplifiers provide signal and current gain to drive the speakers. The outputs of the amplifiers are mixed to two channels for the headphones and to provide the left and right channel auxilliary outputs.

THREE CHANNEL CHORUS [Dwg. 30]

The upper and lower keyboard strings are applied through the Chorus Audio Mixer IC7 (30-G6) to the three channel chorus board. The Orch. Plus, Orchestral, Main Reed/String, Solo and Flute are routed to the chorus audio mixer when the appropriate chorus switcher is enabled.

FLUTE/STRING CHORUS MODULATOR [Dwg. 11]

The Fast Clock (19.6Hz) and the Slow Clock (2.2Hz) frequencies are each divided by three to create three clock frequencies with 120 degrees of phase shift. The like phases of fast and slow clock are combined through filters to create a low frequency sine wave modulated by the fast clock. Each output is amplified through a driver and applied to a voltage controlled oscillator (VCO). As the voltage applied to the VCO varies, the frequency of the oscillator varies from approximately 220KHz to 385KHz.

Each VCO output is applied to a bucket brigade. The audio signal applied to the bucket brigade is shifted through it at the rate of the VCO clock. Because the VCO frequency varies, a phase shift is created. The low pass filter removes the VCO clock from the audio signal. The three phase modulated audio signals are returned to the output mixer (Dwg. 30).

CHORUS SQUELCH [Dwg. 30]

Normally, the output of Comparator IC6C (30-G8) is a positive voltage, keeping Buffer Q10 (30-G9) biased on. The buffer applies a positive voltage to the three Chorus Squelch Switchers (30-G10). These transistors are turned on, grounding any noise which may be generated by the chorus modulator.

When a key is pressed, the audio signal output from the Chorus Audio Mixer IC7A (30-G6) is applied to the bucket brigades (Dwg. 11) and to Squelch Amplifier IC6B (30-G6). The squelch amplifier output is applied to a full wave rectifier IC6A and IC6D which rectifies the audio signal into a positive DC voltage. This DC voltage is applied to comparator IC6C (30-G8). The output of the comparator switches negative, turning buffer Q10 off which turns off the chorus squelch switchers. The phase modulated audio is now applied to the volume regulators.

ADJUSTMENTS

ADJUSTMENTS

All adjustments have been made at the factory. Normally, the only time an adjustment would be required in the field is when a repair has been made to the specific circuit where the adjustment is located.

1. Unless specified, all tabs are off and controls at minimum.
2. Some adjustments are critical [the ones with factory-selected components]. Without the proper equipment, it may be better to leave the adjustment alone.

SCHEMATIC 1

Board 20

MAIN OSCILLATOR TUNING PROCEDURE

- 1) Press and hold the upper keyboard C2 key for all steps of this procedure.
- 2) Press the 16-foot Trombone tab.
- 3) Using a tuning fork or other tuning device whose frequency corresponds to the key being held, adjust the tuning coil using a non-metalic tuning wand for a zero beat between the organ tone and the tuning device.
- 4) When this note is properly tuned, the TOS tuning is locked in.
- 5) Go to the Orchestral Symphonizer Tuning Procedure and begin with Step 2.

SCHEMATIC 2

Board 8

HAWAIIAN GUITAR/VIOLIN CHORUS OSCILLATOR MAXIMUM SPEED ADJUSTMENT

- 1) Connect oscilloscope to IC2 pin 6.
- 2) Turn Maximum Speed Adjustment VR1 until on cycle takes approximately 160mS.
- 3) This correctly adjusts the Chorus Oscillator for 6.3Hz.

BIAS ADJUSTMENT

To adjust the DC offset voltage:

- 1) Turn the Hawaiian Guitar preset on and the Percussion Volume Control to maximum.
- 2) Press the Magic Genie Chords tab and the AOC Organ tab.
- 3) Press a key on the lower keyboard and hold down a key on the upper keyboard.
- 4) Adjust the Bias Adjustment VR2 clockwise until the signal begins to distort.
- 5) Observe the position of the adjustment then turn VR2 counterclockwise until the signal begins to distort.
- 6) Adjust the potentiometer to the midpoint of the distortion regions.

SCHEMATIC 3

Board 18

VIBRATO SPEED ADJUSTMENT

- 1) Connect oscilloscope to the emitter of Vibrato Oscillator Q2.
- 2) Turn Vibrato Speed Adjust VR1 until one cycle of the Vibrato Oscillator is completed in approximately 160mS.
- 3) The vibrato speed is now adjusted to 6.3Hz.

VIBRATO DEPTH ADJUSTMENT

- 1) Connect oscilloscope to wiper of Vibrato Depth Adjust VR2 (S5-1).
- 2) Adjust VR2 for a 4 VPP indication on oscilloscope.

ADJUSTMENTS

GLIDE ADJUSTMENT

- 1) Turn on an upper keyboard tab.
- 2) Press the C3 keyswitch.
- 3) Press the glide footswitch. The C3 frequency should detune one semitone (C pitch changes to B).
- 4) If adjustment is required, place a resistor substitution box, decade box or potentiometer in place of the factory-tailored resistor (if any at the anode side of D12).
- 5) Adjust value to obtain the one semitone shift in frequency when the glide switch is pressed.
- 6) Determine the value of the variable resistor then install a fixed resistor.
- 7) Re-check the glide.

SCHEMATIC 6

Board 10

SYMPHONIC STRING THUMP ADJUSTMENT

- 1) Place expression pedal at maximum expression (full volume).
- 2) Place Upper String Volume Control at maximum.
- 3) Press Symphonic Viola preset and Upper String Attack tab.
- 4) Repeatedly, press any key on the upper keyboard.
- 5) Adjust Symphonic String Thump Adjust for minimum keydown thump.

SCHEMATIC 7

Board 3

PERCUSSION THUMP ADJUSTMENT

The purpose of this adjustment is to minimize the DC transient (thump) which may occur when playing any of the repeat percussion voices (Harmonic 4', 2-2/3', Bells, Mandolin and Banjo). To adjust:

- 1) Place expression pedal at maximum expression and Percuss Volume Control to maximum.
- 2) Turn Repeat Speed Control to minimum.
- 3) Turn Repeat Percuss. tab on.
- 4) Turn Harmonic 4 preset on.
- 5) Adjust VR1 for minimum thump.

NOTE: If thump cannot be reduced satisfactorily by adjustment, then replace Modulator IC1.

GENIE THUMP ADJUSTMENT

The purpose of this adjustment is to minimize the DC transient (thump) which may occur when the lower keyboard Piano, Banjo or Guitar tabs are on and a rhythm is playing. To adjust:

- 1) Place expression pedal at maximum expression and Genie Volume Control to full volume.
- 2) Turn rhythm volume control to minimum.
- 3) Place rhythm balance control to extreme right of control movement.
- 4) Place Rhythm Speed Control to 380.
- 5) Select Metronome Rhythm.
- 5) Adjust VR2 for minimum thump.

NOTE: If thump cannot be reduced satisfactorily by adjustment, replace Modulator IC2.

SCHEMATIC 10

Board 5

PHASE 1, PHASE 2 BIAS ADJUSTMENT

To adjust the phase 1 or phase 2 bias:

- 1) Turn on the Flute Chorus and Chorus Celeste tabs.
- 2) Turn on the Flute 16 tab.
- 3) Play a note on the upper keyboard.
- 4) Turn bias adjustment clockwise until distortion occurs.
- 5) Observe position of the potentiometer then turn the adjustment counterclockwise until distortion occurs.
- 6) Proper setting is the midpoint of the distortion regions.

ADJUSTMENTS

SCHEMATIC 19 & 20 Board 25A & 25B

OSCILLATOR TUNING PROCEDURE

- 1) Place organ in Orchestration Plus tuning mode as follows:
 - a) Turn organ off.
 - b) Place test switches (shown on Schematic 15, Board 31) off.
 - c) Turn test switch one on.
 - d) Turn test switch three on.
- 2) Turn organ on.
- 3) Orch. Plus Voice 1 produces an A pitch (440Hz).
- 4) On Board 24 (Upper Sustain Keyer), connect a jumper wire between the collector and the emitter of Q28.
- 5) Press the Upper Keyboard Flute 8 tab. This provides an A-440 reference pitch.
- 6) Adjust the expression pedal and Orchestration Volume Control for a comfortable listening level.
- 7) With a non-metallic tuning wand, adjust Oscillator 1 Tuning Adjust L1 for a zero beat with the A pitch.
- 8) Turn test switch three off then on.
- 9) Voice 2 may now be tuned by adjusting L2.
- 10) Each time test switch three is toggled, the tuning frequency increments to the next voice channel. (Voice six wraps around to voice one.)
- 11) When all six channels have been checked and/or adjusted, exit from the test mode as follows:
 - a) Turn the test switches off.

Note: If it is desired, the lamp chase routine may be enabled by placing test switch two on.

 - b) Turn the organ off, then on to restore normal operation.
- 12) Remove jumper wire from Q28 on Board 24.

REFERENCE VOLTAGE PREAMP

The DC voltage output from the Reference Voltage Preamp is applied to a comparator to determine the duty cycle of the pulse wave.

- 1) Enter tuning mode as follows:
 - a) Turn organ off.
 - b) Place test switches (shown on Schematic 15, Board 31) off.
 - c) Turn test switch one and test switch three on.
- 2) Turn organ on. Orch. Plus Voice 1 produces an A pitch (440Hz).
- 3) Toggle test switch three as required to select channel to be checked.

Each time test switch three is toggled off then on, the frequency increments to the next voice channel (voice six wraps around to voice one).
- 4) Connect an oscilloscope to the emitter of the Audio Emitter Follower of the voice to be checked.
- 5) Waveform should have approximately .75mS pulse width, repetition rate = 2.2mS.
- 6) If adjustment is required:
 - a) Turn organ off.
 - b) Remove the factory tailored resistor from the input of the Reference Voltage Preamp.
 - c) Install a decade box, resistor substitution box or potentiometer (approximately 400K) in place of the tailored resistor.
 - d) Turn organ on and toggle switch 3 (as required) to the channel being adjusted.
 - e) Adjust the resistor value to obtain a pulse width of approximately .75mS.
 - f) Install the equivalent fixed resistor and recheck the pulse width. Remember to toggle switch 3 (if required) to the channel being adjusted.
- 7) Turn test switch three off then on.
- 8) The next voice may be checked beginning with step 4.
- 9) To return to normal operations:
 - a) Turn the test switches off.

Note: If it is desired, the lamp chase routine may be enabled by placing test switch two on.

 - b) Turn the organ off and then on to restore normal operation.

ADJUSTMENTS

SCHEMATIC 21 Board 25A & 25B

FILTER CONTROL PULSE WIDTH MODULATOR

- 1) Enter the tuning mode as follows:
 - a) Turn organ off.
 - b) Place test switches (shown on Schematic 15, Board 31) off.
 - c) Turn test switch one and test switch three on.
- 2) Turn organ on. Voice 1 produces an A (440Hz) pitch.
- 3) Connect an oscilloscope to the test point at the output of the Inverting Buffer (IC12 Pin 3, IC45 Pin 11, IC13 Pin 11). The pulse width should be approximately .2uS with a repetition rate of about 5uS.
- 4) If adjustment is required:
 - a) Remove the tailored resistor from the emitter of Filter Control Pulse Width Modulator and insert a decade box, resistor substitution box or potentiometer in place of the tailored resistor.
 - b) Adjust the value of the variable resistor to obtain a pulse width of .2uS.
 - c) Install the equivalent fixed resistor and recheck the pulse width.
- 5) Turn test switch three off then on.
- 6) The next channel may be checked or adjusted beginning with step three.
- 7) To return from the tuning mode:
 - a) Turn test switches off.

Note: If it is desired, the lamp chase routine may be enabled by placing switch two on.

 - b) Turn organ off then on to restore normal operation.

MODULATOR THUMP ADJUSTMENT

- 1) Enter De-Thumping mode as follows:
 - a) Turn organ off.
 - b) Turn all test switches (shown on Schematic 15, Board 31) off.
 - c) Turn test switch one, three and seven on.
- 2) Turn all six audio switches off (Board 25A and 25B).
- 3) Turn organ on.
- 4) Turn Voice 1 audio switch on.
- 5) Adjust Modulator Thump Adjust for minimum thump.
- 6) Turn Voice 1 audio switch off.
- 7) Repeat steps 4, 5 and 6 for Voice two through six.
- 8) To return from De-thumping mode:
 - a) Place test switches off.

Note: If the lamp chase routine is desired, place test switch two on.

 - b) Turn organ off then on to restore normal operation.
- 9) Turn all six audio switches on.

SCHEMATIC 22 Board 16

ORCHESTRAL SYMPHONIZER MASTER OSCILLATOR TUNING PROCEDURE

- 1) Check the tuning of the Main Oscillator. (See Main Oscillator Tuning Procedure.)
- 2) Press the 16' Trombone tab and the Orchestral Symphonizer Trumpet preset.
- 3) Set the Orchestral Tuning and Orchestral Volume Controls to midpoint.
- 4) Hold down the upper keyboard C2 key.
- 5) Tune the Orch. Symp. Master Oscillator Tuning Coil with a non-metallic tuning wand for a zero beat.
- 6) This completes the tuning of the Orchestral Symphonizer.
- 7) Go to the Solo Oscillator Tuning Procedure and begin with Step 3.

SCHEMATIC 23 Board 17

ORCHESTRAL SYMPHONIZER GLIDE ADJUST

When an orchestral symphonizer preset (except grand piano, clavichord or harpsichord) is on and

ADJUSTMENTS

the glide switch is pressed, the note being played should detune by one semitone (i.e., C detunes to B).

If adjustment is required:

- 1) Remove the factory selected resistor from the base circuit of Q27.
- 2) Insert a resistor substitution box, decade box or potentiometer in place of the selected resistor.
- 3) Adjust value to obtain one semitone detuning when the glide switch is pressed.
- 4) Determine the value of the substitute resistor then install the equivalent fixed resistor.
- 5) Recheck the glide.

SCHEMATIC 24

Board 17

INITIAL FREQUENCY ADJUST

- 1) Set Orchestral Symphonizer Volume Control to full volume.
- 2) Press Orch. Symp. Trumpet Preset
- 3) On Board 1, connect oscilloscope to S5-2 (Brass Volume Regulator Emitter Follower Q16).
- 4) Press and hold the upper C3 keyswitch.
- 5) Turn the Initial Frequency Adjustment full clockwise and observe the peak-to-peak voltage.
- 6) Turn the Initial Frequency Adjustment full counterclockwise and observe the peak-to-peak voltage.
- 7) Adjust the Initial Frequency Adjustment for the midpoint of the maximum and minimum peak-to-peak levels.

SCHEMATIC 25

Board 1

VOLTAGE CONTROLLED FILTER THUMP ADJUSTMENT

- 1) Turn organ off.
- 2) Unplug S2 (Board 1).
- 3) Turn organ on.
- 4) Place Orchestral Volume Control at full volume.
- 5) Place expression pedal at full expression.
- 6) Turn Wow Preset on.
- 7) Hold down the upper C1 keyswitch.
- 8) Repeatedly press the C5 keyswitch and adjust the thump adjust VR2 for minimum thump.
- 9) Turn organ off and re-insert S2.

BIAS ADJUST

To adjust the bias:

- 1) Press the Orchestral Symphonizer French Horn preset.
- 2) Play a chord on the upper keyboard.
- 3) Turn bias adjust clockwise until distortion occurs.
- 4) Observe position of potentiometer then turn the bias adjust counterclockwise until distortion occurs.
- 5) Proper setting is the midpoint between the distortion regions.

SCHEMATIC 26

Board 12

GLIDE ADJUSTMENT

When a solo symphonizer preset (except piano or clavacin) is on and the glide switch is pressed, the note being played should detune by one semitone (i.e., C detunes to B).

If adjustment is required:

- 1) Remove the factory tailored resistor from pin 6 of IC22.
- 2) Insert a resistor substitution box, decade box or 500K potentiometer in place of the tailored resistor.
- 3) Adjust value to obtain one semitone detuning when the glide switch is pressed.
- 4) Determine the value of the substitute resistor then install the equivalent fixed resistor.
- 5) Recheck the glide.

ADJUSTMENTS

SOLO OSCILLATOR TUNING PROCEDURE

- 1) Check the tuning of the Main Oscillator. (See Main Oscillator Tuning Procedure).
- 2) Check the tuning of the Orch. Symp. Master Oscillator. (See Orch. Symp. Master Oscillator Tuning Procedure.)
- 3) Press the 16' Trombone tab and the Solo Symphonizer Trombone preset.
- 4) Set the Solo Tuning and Solo Volume Controls to midpoint.
- 5) Hold down the upper keyboard C2 key.
- 6) Adjust the Solo Oscillator Tuning Coil using a non-metalic tuning wand for a zero beat.
- 7) This completes the Solo Oscillator Tuning Procedure.
- 8) Go to the Orchestra Plus Tuning Procedure.

SCHEMATIC 30

Board 9

MAXIMUM VOLUME ADJUSTMENT

- 1) Press upper Trombone and Clarinet tabs.
- 2) Place Expression Pedal at maximum (full volume).
- 3) Press the upper C1, E1, G2, A#2 and C2 keyswitches simultaneously (C7 chord).
- 4) Adjust Maximum Volume potentiometer for maximum volume or lower without audible distortion.

MINIMUM VOLUME ADJUSTMENT

- 1) Press lower Piano tab and turn Genie Volume Control to maximum.
- 2) Place expression pedal at minimum (softest volume).
- 3) Press lower C2 keyswitch.
- 4) Adjust Minimum Volume potentiometer until the audio signal is barely audible.

SCHEMATIC 31

AMPLIFIER BIAS ADJUSTMENT

[To be performed after replacement of amplifier components.]

- 1) Turn off power, remove back and lower the Power Supply/Amp tray.
- 2) Connect a milliammeter as follows: positive lead to +55 volt terminal and negative lead to the collector of Q14 side of the fuse holder.
- 3) Ground audio input to amplifier at S1-2.
- 4) Turn on power and allow Power Supply to stabilize.

CAUTION: In the following steps, failure to use a non-conductive extraction tool may result in personal injury or damage to the instrument.

- 5) Remove the 3-amp fuse located on the Amplifier Board using a fuse puller or other non-conductive extractor.
- 6) Current should read between 20 and 30mA. (If current reading is correct, proceed to Step 15.)
- 7) If adjustment is necessary, turn off power and remove the factory-tailored resistor.
- 8) Connect a variable resistor (decade box, potentiometer, resistor substitution box, etc.) to the wire wrap pins. The initial value should be approximately 10K ohms.
- 9) Re-insert fuse into holder.
- 10) Turn on power and allow power supply to stabilize.
- 11) Remove the 3-amp fuse located on the Amplifier Board using a fuse puller or other non-conductive extractor.
- 12) Adjust variable resistor for a current reading of 25mA.
- 13) Turn off power and solder proper resistor to wire wrap pins. Re-insert fuse into holder.
- 14) Continue checkout procedure with Step 4.
- 15) Turn off power, remove milliammeter and ground leads, insert fuse.

SCHEMATIC 32

Board 50

+15 VOLT REGULATOR ADJUSTMENT

Connect a DC voltmeter to Lug 21 (Board 50). Voltage should measure +15VDC.

ADJUSTMENTS

If adjustment is required:

- 1) Turn organ off.
- 2) Remove the tailored resistor and insert a decade box resistor substitution box or potentiometer.
- 3) Turn organ on and adjust variable resistor for a +15VDC indication on the voltmeter.
- 4) Turn organ off.
- 5) Remove the variable resistor and insert the equivalent fixed resistor.
- 6) Turn organ on and recheck Lug 21 for +15VDC.

+5 VOLT REGULATOR ADJUSTMENT

Connect a DC voltmeter to Lug 36 (Board 50). Voltage should measure +5 volts DC.

If adjustment is required:

- 1) Turn organ off.
- 2) Remove the tailored resistor from pins 5 and 6 of IC1 and insert a decade box, resistor substitution box or potentiometer in place of the tailored resistor.
- 3) Turn organ on and adjust variable resistor for a +5VDC indication on the voltmeter.
- 4) Turn organ off.
- 5) Remove the variable resistor and insert the equivalent fixed resistor.
- 6) Turn organ on and recheck Lug 36 for +5VDC.

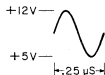
WAVEFORMS

SCHEMATIC 1

BOARD 20

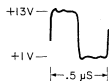
1 MASTER OSCILLATOR

Emitter Q1



2 TOS INPUT

IC13 Pin 2
(Test Point)



3 TYPICAL DIVIDER OUTPUT



* Frequency depends
on output
being observed.

SCHEMATIC 2

BOARD 8

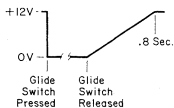
1 CHORUS OSCILLATOR KEYDOWN DELAY

Collector Q8

Orchestral Percussion
Hawaiian Guitar
Preset On

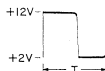


Orchestral Percussion
Hawaiian Guitar
Preset On



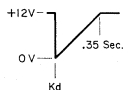
2 VOLTAGE CONTROLLED OSCILLATOR

IC4 Pin 1

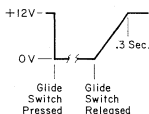


Orch. Perc. Preset	T _{min}	T _{max}
Violin	4.8 μs	5 μs
H. Guitar	3.6 μs	5 μs

Orchestral Percussion
Violin
Preset On

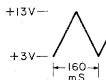


Orchestral Percussion
Violin
Preset On



3 CHORUS OSCILLATOR

IC2 Pin 6



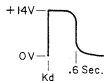
WAVEFORMS

SCHEMATIC 3

BOARD 18

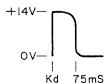
1 VIBRATO DELAY TRIGGER

ICI Pin 11
Vibra Harp Preset On



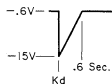
2 SUSTAIN CANCEL TRIGGER

ICI Pin 3
Any Percussion Preset except Chimes or Bells



3 SYMPHONIC STRING MODULATOR DRIVER

Emitter Q34
Upper String Preset On
Upper String Attack Tab On



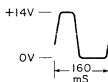
4 VIBRATO OSCILLATOR

Emitter Q2



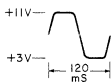
5 LOW FREQUENCY FLUTE LAMP DRIVER

Emitter Q14
Normally = +14V
Vibra Trem Flute Tab On



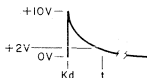
6 VIBES/VIBRA HARP LAMP DRIVER

Emitter Q15
Normally = Zero
Vibes or Vibra Harp On



7 PERCUSSION/REPEAT DRIVERS

S4 Pin 1

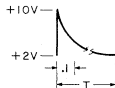


Normal Perc.
long

Preset	t Sec	t Sec
4' Harm.*	.25	.5
2 2/3' Harm.*	.25	.5
Bells *	.25	.5
Vibes	.5	.5
H. Guitar	.5	.5

*Repeat Preset

Repeat Tab On
Bells Preset On



Repeat Speed	T Sec
Min	.25
Max	.08

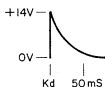
WAVEFORMS

SCHEMATIC 3 (Cont.)

BOARD 18

8 KEYDOWN PULSE DRIVER

Emitter Q16

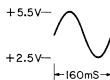


Decay at the Cathode
of D9=20 Sec

9 VIBRATO/GLIDE DRIVER

Emitter Q4

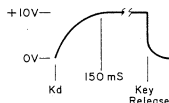
Normally = +3.6V
Glide Switch pressed = +10V
Vibrato Tab On



7 SLOW ATTACK DRIVER

S4 Pin 1

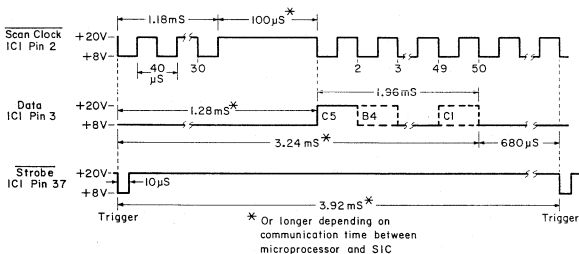
Violin or
Accordion Preset On



BOARD 24

8 UPPER KEYBOARD DECODER TIMING

Connect S9-3 (Keyer Strobe) to External Trigger Input of Oscilloscope
Trigger - Negative Edge
Time Base = .5 mS/Div.
Use high impedance probe (10:1)
Upper C5 Keyswitch Pressed and held



WAVEFORMS

SCHEMATIC 4

BOARD 10

1 UPPER KEYBOARD FLUTE MIXING PREAMP

Connect Oscilloscope to SI-2

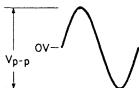
Upper A2
Keyswitch Pressed

Flute Tab	Amplitude Volts (Peak to Peak)
16	.88
8	.5
5 $\frac{1}{3}$	.48
4	.44
2 $\frac{2}{3}$	.46
2	.38
1	.38

Custom Flute Preset Tab On
Selected Preset Volume Control = Max

Flute Volume Control	Amplitude Volts (Peak to Peak)
16	.8
8	.44
5 $\frac{1}{3}$	.42
4	.38
2 $\frac{2}{3}$	.42
2	.34
1	.34

TYPICAL FLUTE WAVEFORM



2 FLUTE PREAMPS

Upper A2 Keyswitch Pressed

Board	Footage	Filter	Connect Scope	Amplitude Volts (Peak to Peak)
10	16	IC3 Pin 10	SI-6	1.4
10	8	IC2 Pin 12	SI-1	1.5
6	5 $\frac{1}{3}$	IC1 Pin 12	S3-5	1.4
10	4	IC2 Pin 3	S4-9	1.3
6	2 $\frac{2}{3}$	IC1 Pin 10	S3-3	1.4
6	2	IC1 Pin 4	S3-1	1.2
6	1	IC1 Pin 3	S3-2	1.2

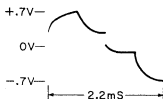
3 REED/STRING PREAMPS

Upper A2 Keyswitch Pressed
Input Coupling - AC

Footage	Connect Scope	Amplitude Volts (Peak to Peak)
16	IC3 Pin 3	.9
8	IC2 Pin 10	1.2
4	IC2 Pin 4	1.1

4 8'HARMONIC MIXER

IC1 Pin 4
Connect Oscilloscope to S4-6
Kinura or Accordion On
Upper A2 Keyswitch Pressed



5 LOW FREQUENCY FLUTE PREAMP

Connect Oscilloscope to SI-8
Flute 16' Tab On
Upper A1 Keyswitch Pressed

Amplitude = .34Vp-p

6 VIBES/VIBRA HARP PREAMP

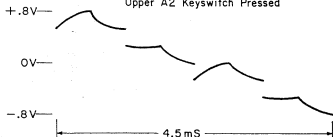
IC3 Pin 12

Connect Oscilloscope to SI-2
Amplitude Modulated Audio Envelope
Vibes or Vibra Harp Preset On
Upper A2 Keyswitch Pressed



7 16'HARMONIC MIXER

IC1 Pin 10
Connect Oscilloscope to S4-4
Cornet or Trombone Tab On
Upper A2 Keyswitch Pressed



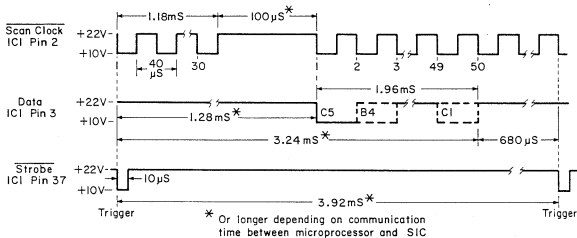
WAVEFORMS

SCHEMATIC 5

BOARD 23

UPPER FRACTIONAL KEYS TIMING

Connect SIO-4 (Keyer Strobe) to External Trigger Input of Oscilloscope
 Trigger - Negative Edge
 Time Base = .5mS/Div.
 Use high impedance probe (10:1)
 Upper C5 Keyswitch pressed and held



SCHEMATIC 6

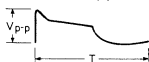
BOARD 10

1 UPPER VIOLINA PREAMP

IC4 Pin 3 = .36V_{p-p}, T = 1.1ms

UPPER VIOLA PREAMP

IC4 Pin 12 = .52V_{p-p}, T = 2.25ms



Upper A2 Keyswitch Pressed

2 UPPER SYMPHONIC STRING PREAMP

IC4 Pin 4
 Connect Oscilloscope to S8-1
 Upper A2 Keyswitch Pressed

Preset	Amplitude Volts (Peak to Peak)
Violina	.44
Viola	.5
Cello	.45

3 UPPER SYMPHONIC STRING OUTPUT AMPLIFIER

Emitter Q4

Upper String Volume Control = Max
 Connect Oscilloscope to S8-3
 Upper A2 Keyswitch Pressed

Preset	Amplitude Volts (Peak to Peak)
Violina	.7
Viola	1.0
Cello	.8

SCHEMATIC 7

BOARD 3

GENIE ACCENT TRUTH TABLE

- At least two lower keyboard tabs pressed. (Piano, Guitar, Banjo)
- Rhythm playing.

LOWER TABSWITCH			Normal Modulation	
Piano	Guitar	Banjo		Accent
ON	ON	OFF	Piano	Guitar
ON	OFF	ON	Piano	Banjo
OFF	ON	ON	Guitar	Banjo
ON	ON	ON	Piano & Guitar	Banjo

WAVEFORMS

SCHEMATIC 7 (Cont.)

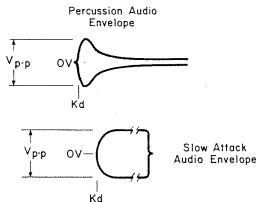
BOARD 3

1 UPPER KEYBOARD PERCUSSION PREAMP

Connect Oscilloscope to SI-14
Upper A2 Keyswitch Pressed

Orchestral Percussion Preset	Amplitude at Keydown (Peak to Peak)
4' Harmonic	3.6V
2 $\frac{2}{3}$ ' Harmonic	4V
Bells	4.8V
Vibes	7V/4V*
Vibra Harp	4V
Chimes	1.3V
Accordion	2V
H. Guitar	4V/2.2V*
Violin	1.8V

*At Keydown/After Decay



2 LOWER KEYBOARD PREAMP

Connect Oscilloscope to SI-2
Lower A2 Keyswitch Pressed

Genie Voice Tab	Amplitude Volts (Peak to Peak)
Piano	1.6
Guitar	1.8
Banjo	1.5

3 VOX HUMANA PREAMP

Connect Oscilloscope to SI-3
Lower A2 Keyswitch Pressed
Vox Humana Tab On

Volume Tab	Amplitude Volts (Peak to Peak)
Soft	.15
Lower Med	.3
Lower Full	.5

4 REED/STRING PREAMP

Connect Oscilloscope to S2-7

Percussion Volume Control-Maximum
Upper A2 Keyswitch Pressed

Tab or Preset	Amplitude Volts (Peak to Peak)
Trombone	1.5
Clarinet	1.7
Cornet	2.4
Kinura	1.6
4' Harmonic	2.5 *
2 $\frac{2}{3}$ ' Harmonic	2.6 *
Bells	3.2
Vibes	5.5/3.2*
Vibra Harp	3.0
Chimes	1.0
Accordion	1.6
H. Guitar	3.0/1.5
Violin	1.3

* Keydown after decay

Genie Volume Control-Maximum
Lower A2 Keyswitch Pressed

Tab	Amplitude Volts (Peak to Peak)
Piano	2.2
Guitar	2.5
Banjo	2.2

WAVEFORMS

SCHEMATIC 8

BOARD 7

1 LOWER KEYBOARD PREAMPS

Lower A3 Keyswitch Pressed

	Preamp	Connect Scope	Amplitude Volts (Peak to Peak)
2'	IC1 Pin 4	S6-1	1.3
4'	IC2 Pin 4	S5-6	1.1
8'	IC2 Pin 10	S7-15	1.2
Diapason	IC1 Pin 3	S5-4	2.1
* Harmonic Mixer	IC2 Pin 3	S5-5	1.2

*

* Input coupling AC

2 FLUTE MIXING PREAMP

IC1 Pin 12

Connect Oscilloscope to S7-5

Upper A2 Keyswitch Pressed

Upper Flute 8 Tab On

Amplitude = .22V_{pp}

Lower A3 Keyswitch Pressed

Lower Flute 8 Tab On

Volume Switcher	Amplitude Volts (Peak to Peak)
OFF	.1
MED.	.18
FULL	.36

3 LOWER KEYBOARD FLUTE PREAMP

IC1 Pin 10

Lower A3 Keyswitch Pressed

Tab	Amplitude Volts (Peak to Peak)
2'	.75
4'	.7
8'	.7

Custom Flute Preset Tab On

Lower A3 Keyswitch Pressed

Custom Vol. Control (Max)	Amplitude Volts (Peak to Peak)
2'	.7
4'	.65
8'	.7

SCHEMATIC 9

BOARD 21

1 LOWER KEYBOARD DECODER TIMING

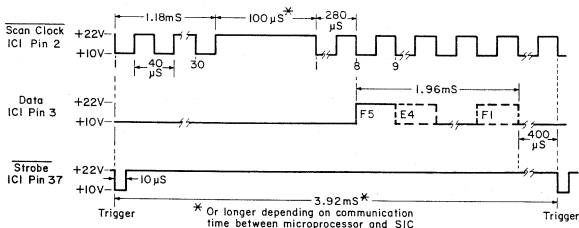
Connect S9-10 (Keyer Strobe) to External Trigger Input of Oscilloscope

Trigger - Negative Edge

Time Base = .5mS/Div.

Use high impedance probe (10:1)

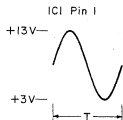
Lower F5 Keyswitch Pressed and held



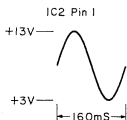
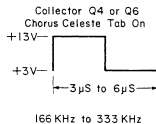
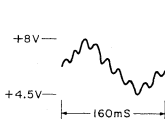
SCHEMATIC 9 (Cont.)BOARD 72 LOWER KEYBOARD STRING PREAMPS

Lower Symphonic String Volume Control = Max.
Lower A3 Keyswitch Pressed

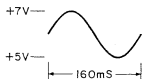
Lower Preset	Connect Oscilloscope	
	S8-2	S8-5
Violina	.7 V _{p-p}	1.4 V _{p-p}
Viola	1.0 V _{p-p}	2.1 V _{p-p}

SCHEMATIC 10BOARD 51 LOW SPEED OSCILLATOR

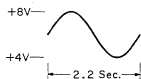
Normal T = 1.5 Sec.
Chorus Celeste Tab On T = 2.2 Sec.

2 HIGH SPEED OSCILLATOR3 VOLTAGE CONTROLLED OSCILLATOR4 CHORUS OSCILLATOR MIXER

Flute Chorus Tab On



Vibra Trem Flute Tab On



Chorus Celeste Tab On

WAVEFORMS

SCHEMATIC 11

BOARD 4

1 FAST CLOCK IC1 Pin 10

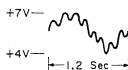


2 SLOW CLOCK IC1 Pin 4



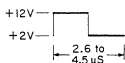
3 TYPICAL VCO DRIVER

IC2 Pin 1, IC3 Pin 1 or IC4 Pin 1



4 TYPICAL VCO OUTPUT

Collector Q6, Q10 or Q14
Chorus Celeste Tab On



222 KHz to 385 KHz

SCHEMATIC 12

BOARD 19

1 DOUBLE BASS PREAMP

IC4 Pin 7

Connect Oscilloscope to S3-4

Pedal A Key Pressed

Double Bass Preset On

Amplitude = 9Vp-p

3 BASS MIXING PREAMP

IC4 Pin 14

Pedal A Key Pressed

Pedal Tab	Amplitude Volts (Peak to Peak)
16	6.0
8	2.8
Diapason	1.5
Diaphone	3.2
Guitar Bass	2.8

Symphonic Bass

Piano	10.0 *
Bass Fiddle	6.0 *
Tuba	12.0

* At
Keydown

2 BASS PREAMP

IC4 Pin 1

Connect Oscilloscope to S3-3

Pedal A Key Pressed

Pedal Tab	Amplitude Volts (Peak to Peak)		
	Soft	Bass Med Tab	Bass Full Tab
16	1.2	2.2	5.2
8	.5	1.1	2.4
Diapason	.28	.6	1.4
Diaphone	.6	1.2	2.7
Guitar Bass	.5	1.1	2.4

Symphonic Bass

Piano	1.9 *	4.0 *	9.0 *
Bass Fiddle	1.2 *	2.5 *	5.0 *
Tuba	2	4.5	10

* At Keydown

SCHEMATICS 13, 14

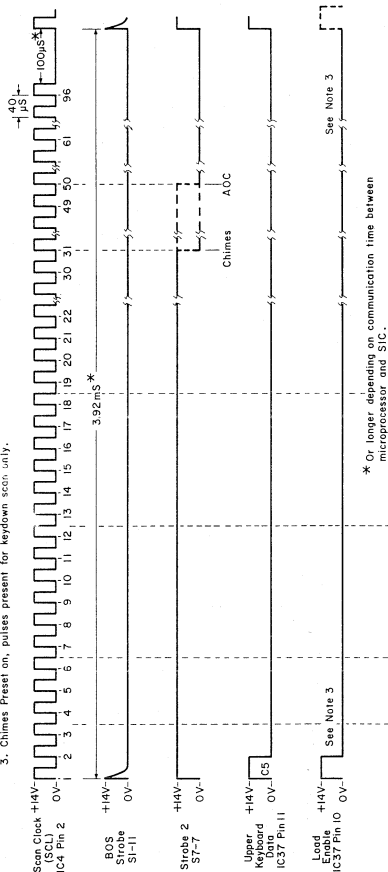
BOARD 15

5 PERCUSSION/AOC WINDOW GENERATOR

Connect SI-11 (BOS Test Point) to External Trigger Input of oscilloscope. Trigger = Positive Edge

Notes:

1. AOC tab on, Magic Chord tab on, Lower Keyboard C Chord pressed, Upper Keyboard C5 key pressed & held.
2. Turn on AOC Open Harmony tab.
3. Chimes Preset on, pulses present for keydown scan only.



* Or longer depending on communication time between microprocessor and SIC.

SCHEMATICS 13, 14



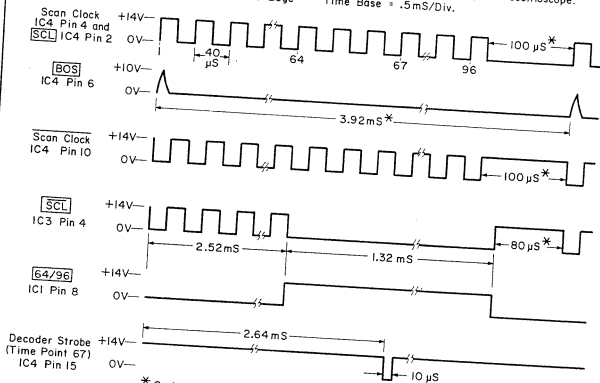
WAVEFORMS

SCHEMATIC 13 & 14

BOARD 15

1 KEYBOARD ENCODER CLOCK AND STROBE TIMING

Connect SI-11 ([BOS] Test Point) to External Trigger input of oscilloscope.
Trigger - Positive Edge Time Base = .5mS/Div.

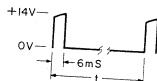


* Or longer depending on communication time between microprocessor and SIC

2 REPEAT $\div 2$ SWITCHER

Collector Q10

Connect oscilloscope to SI-3



Repeat Speed min. $t = 260$ mS
Repeat Speed max. $t = 86$ mS

BOARD 17

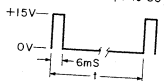
3 KEYDOWN RESET

Collector Q12
Press any Upper Keyboard Key
Trigger = Negative Edge



4 REPEAT OSCILLATOR

IC10 Pin 4
Connect oscilloscope to S6-4



Repeat Speed min. $t = 130$ mS
Repeat Speed max. $t = 43$ mS

WAVEFORMS

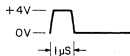
SCHEMATIC 15

BOARD 32

1 IO/M

In-Out / Memory

IC1 Pin 34



2 RHYTHM CLOCK

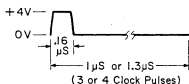
IC1 Pin 7



3 ALE

Address Latch Enable

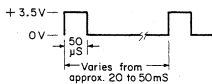
IC1 Pin 30



4 TRAP

IC1 Pin 6

Connect Oscilloscope to S11-1



5 READ

IC1 Pin 32



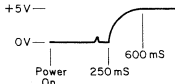
6 WRITE

IC1 Pin 31



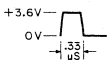
7 POWER ON RESET

IC1 Pin 36



8 CLOCK

IC1 Pin 37



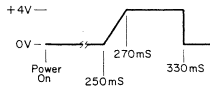
9 CRYSTAL

IC1 Pin 1



10 RESET

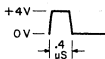
IC1 Pin 3



BOARD 31

11 DELAYED WRITE

IC4 Pin 8



12 CHIP SELECT DECODER

IC8 Typical Output



13 TYPICAL ROM

SELECT DECODER OUTPUT

IC17 Pin 1



WAVEFORMS

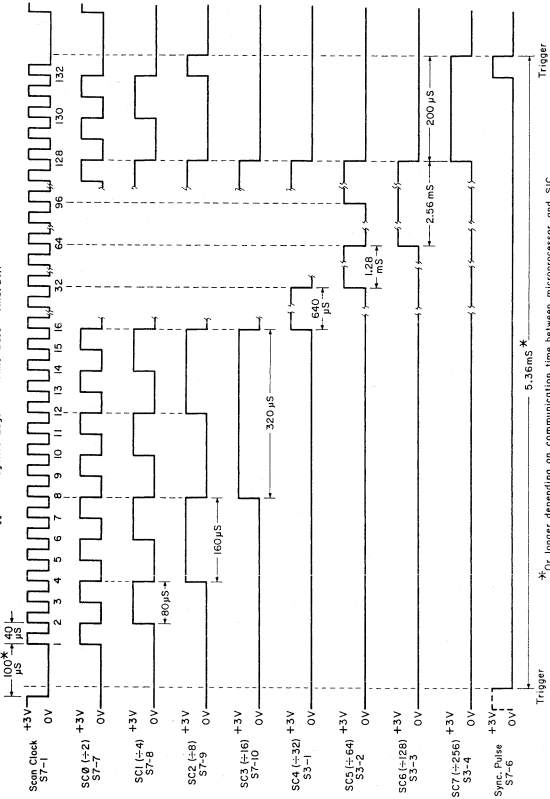
SCHEMATIC 15

BOARD 32

15 SERIAL INTERFACE CONTROLLER I (Lighted Burton Scan Logic) IC24

Connect S7-6 (Sync. Pulse) to External Trigger Input of Oscilloscope

Trigger = Negative Edge Time Base = 1mS/Div.



*Or longer depending on communication time between microprocessor and SIC

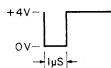
SCHEMATIC 16

BOARD 30

TYPICAL CHIP SELECT DECODER OUTPUT

IC14 or IC15

NOTE: These pulses are extremely difficult to observe because they occur only when the data in a PIC is being updated.



SCHEMATIC 17

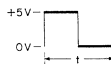
BOARD 30

PROGRAMMABLE OSCILLATOR PERIPHERAL

1 IC2 Pin 4



2 IC2 Pin 20

Rhythm Speed min. $t = 44\text{ms}$, max. $t = 6.4\text{ms}$

3 IC2 Pin 19

Rhythm Speed min. $t = 340\mu\text{s}$, max. $t = 50\mu\text{s}$

4 4 MHz OSCILLATOR

IC1 Connect Oscilloscope to S7-2



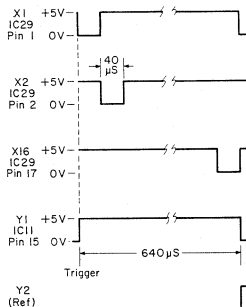
SCHEMATIC 18

BOARD 32

X-SCAN, Y-SCAN TIMING DIAGRAM

Connect S3-1 to External Trigger Input of Oscilloscope

Trigger = Positive Edge



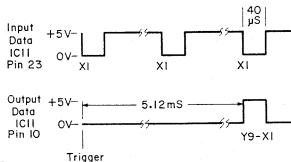
2 Y-LINE SELECT MULTIPLEXER

NOTE: Data present only when pushbutton pressed 8 held or scan tabswitch is pressed

Connect S3-4 to External Trigger Input of Oscilloscope

Magic Key Memory Tab On

Trigger = Negative Edge



SCHEMATICS 19, 20, 21

BOARD 25A, 25B

1. Turn organ off.
2. Place the Test Switches (shown on Schematic I5, Bd. 3I) to the off position.
3. Place switch 1 on.
4. Turn organ on.
5. Place switch 3 on, Orch. Plus Voice 1 now outputs an audio frequency (440 Hz).
6. Take readings if desired.
7. Place switch 3 off then on, Orch. Plus Voice 2 now outputs an audio frequency (440 Hz).

Each time switch 3 is toggled the frequency increments to the next channel. (Voice 6 moves to Voice 1)

At conclusion of measurements:

1. Place the test switches off.
2. Turn organ off then on to restore normal operation.

Component references for waveforms shown below

Voice	Master Oscillator Collector	Prog. Oscillator IC29	Pulse Width Flip-Flop	Sawtooth Generator	Audio Attenuators	Audio Emitter Follower	Filter Input Preamp	Audio Modulator
1, 4	Q20	Pin 21	IC18 Pin 3	Q38	Q39, Q34	Q35	IC16 Pin 8	SI-4
2, 5	Q21	Pin 4	IC39 Pin 3	Q30	Q31, Q26	Q27	IC22 Pin 7	SI-3
3, 6	Q22	Pin 5	IC28 Pin 3	Q46	Q45, Q43	Q42	IC10 Pin 7	SI-2

1 MASTER OSCILLATOR

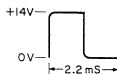
Connect Oscilloscope to collector of transistor to be checked



2 PROGRAMMABLE OSCILLATOR

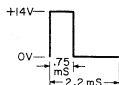
(Square Wave)

Connect Oscilloscope to selected pin of IC29



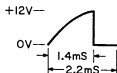
3 PULSE WIDTH FLIP-FLOP

Connect Oscilloscope to Pin 3 of selected IC



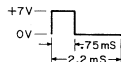
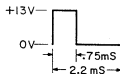
4 SAWTOOTH GENERATOR

Connect Oscilloscope to emitter of transistor to be checked



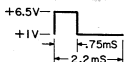
5 AUDIO ATTENUATORS

Connect Oscilloscope to emitter of transistor to be checked



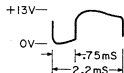
6 AUDIO EMITTER FOLLOWER

Connect Oscilloscope to emitter of transistor to be checked



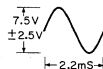
7 FILTER INPUT PREAMP

Connect Oscilloscope to pin of IC to be checked



8 AUDIO MODULATOR

Connect Oscilloscope to pin of socket to be checked



WAVEFORMS

SCHEMATICS 19, 20, 21

BOARD 25A, 25B

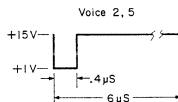
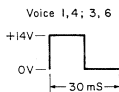
PROGRAMMABLE OSCILLATOR PERIPHERAL

Filter Tune
Enter test mode as indicated above

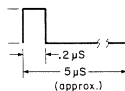
Voice	Filter Tune Pulse Code	Filter Control Inverting Buffers	Keying Envelope Generator
1, 4	IC29 Pin 20	IC12 Pin 3	Q33
2, 5	IC24 Pin 14	IC45 Pin 11	Q25
3, 6	IC29 Pin 19	IC13 Pin 11	Q44

9 FILTER TUNE PULSE CODE

Connect Oscilloscope to desired pin of IC



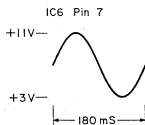
10 INVERTING BUFFERS



11 KEYING ENVELOPE GENERATOR

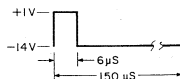
Emitter of transistor = +12 VDC

12 VIBRATO OSCILLATOR



13 GLIDE DISCHARGE SWITCHER

Collector Q10

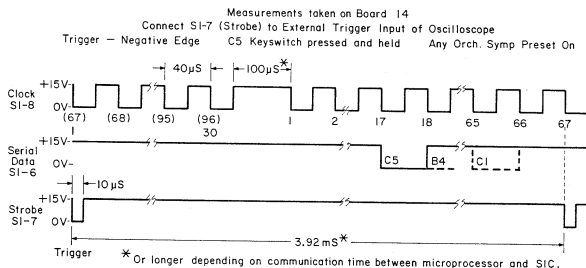


WAVEFORMS

SCHEMATIC 22

BOARDS 13 & 14

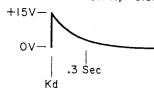
1 SERIAL TO PARALLEL DECODER TIMING DIAGRAM



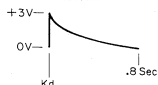
2 ORCH. SYMP. KEYSER DRIVER

Connect Oscilloscope to Emitter Q2 (Board 14)
 Press C1 Keyswitch

Any Piano or Guitar (Except Clavecin)



Clavecin



Connect Voltmeter to Emitter Q2 (Board 14)
 Press C1 Keyswitch

Any Brass preset except Oboe or Krumet Horn - Emitter Voltage = +23 VDC
 Oboe or Krumet Horn - Emitter Voltage = +7.5 VDC

BOARD 16

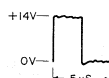
3 ORCH. SYMP. MASTER OSCILLATOR

Emitter Q63



4 DIVIDER

ICI Pin 12

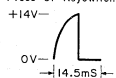


5 SAWTOOTH KEYSER

Orch. Symp. Brass Preset On

Connect Oscilloscope to anode of diode located near base of Pulse Keyer Transistor Q1

Press C1 Keyswitch



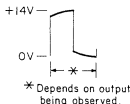
WAVEFORMS

SCHEMATIC 22 (Cont.)

BOARD 16

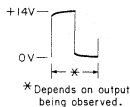
6 TOP OCTAVE SYNTHESIZER

IC2 Typical Output



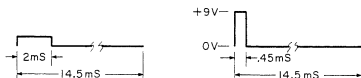
7 FREQUENCY DIVIDER

IC3-14 Typical Output



8 PULSE KEYS

Orch. Symp. Brass Preset On
Connect Oscilloscope to collector of transistor to be checked Q1
Press C1 Keyswitch



SCHEMATIC 23

BOARD 17

1 DELAY TRIGGER

IC10 Pin 11

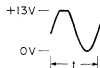
Any Orch. Symp. Preset On



2 TREMOLO / VIBRATO

OSCILLATOR

IC12 Pin 7



Orch. Symp. Trem. Speed Control
min t = 240mS
max t = 130mS

3 VIBRATO / GLIDE

DRIVER

Emitter Q27

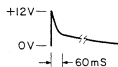
Normal = +5.5VDC

Glide Switch = +11VDC
Pressed

4 REPEAT MODULATOR

DRIVER

Emitter Q21



Repetition rate variable from 90mS to 270mS depending on position of Repeat Speed Control

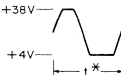
5 ORCH. SYMP. DRIVER

Emitter Q14

Connect Oscilloscope to S2-8

Orch. Symp. Preset	VDC
Normal	+38
Clavecin	+10.5
Krumet Horn	+10.5
Oboe	+10.5

Orch. Symp. Tremolo
Depth Control Maximum



WAVEFORMS

SCHEMATIC 24

BOARD 17

1 INITIAL FREQUENCY PREAMP, FILTER TUNING PREAMP, DRIVER

Connect voltmeter to IC9

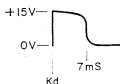
Preset	IC9 Pin 8	IC9 Pin 14	S5-1
Off	-.5V	+11.7V	-2.5V
Trumpet	-.9V	+2.7V	-11.6V
Brass Ensemble	-.8V	+1.8V	-13.7V/-11.2V*
Wow	-2.5V	+1.8V	-13.7V/-11.4V*

* Keydown / After Filter Sweep

2 FILTER ENVELOPE TRIGGER

IC7 Pin 3

Any Orch. Symp. Preset On



Orchestral Custom Preset On

Connect voltmeter to S5-1

Filter Tune	Filter Range	Envelope Sustain	Normal	Filter Follow On	
				C1 Key Pressed	C5 Key Pressed
1	1	1	-13.7V	-14.0V	-13.6V
1	1	8	-13.7V	-14.0V	-13.6V
1	8	1	-13.7V	-14.0V	-5.8V
1	8	8	-9.7V	-13.1V	-8.4V
8	1	1	-11.0V	-13.4V	-8.4V
8	1	8	-11.0V	-13.4V	-8.4V
8	8	1	-11.0V	-13.4V	-8.4V
8	8	8	-1.0V	-11.3V	-1.8V

1 = Minimum 8 = Maximum

3 EMITTER FOLLOWER

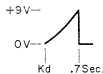
Emitter Q6

Orchestral Custom Symphonizer Preset On

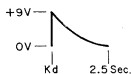
Attack = min.
Decay = min.
Sustain = min.



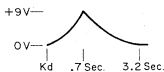
Attack = max.
Decay = min.
Sustain = min.



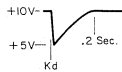
Attack = min.
Decay = max.
Sustain = min.



Attack = max.
Decay = max.
Sustain = min.



Attack = max.
Decay = max.
Sustain = max.



WAVEFORMS

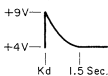
SCHEMATIC 24 (Cont.)

BOARD 17

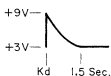
3 EMITTER FOLLOWER

Emitter Q6

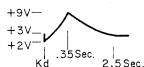
Orch. Symp.
Trumpet Preset On



Orch. Symp. Brass
Ensemble Preset On



Wow Preset On

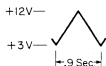


SCHEMATIC 25

BOARD 1

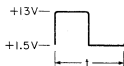
1 CHORUS SPEED OSCILLATOR

IC15 Pin 7



3 VOLTAGE CONTROLLED OSCILLATOR

Collector Q18



$t_{\max} = 3.8\mu\text{s} = 264\text{ KHz}$

$t_{\min} = 3\mu\text{s} = 333\text{ KHz}$

2 VOLUME REGULATORS

Input Coupling AC
Orch. Symp. Volume Maximum
Upper Keyboard A2 Keyswitch Pressed

Preset	String Regulator S5-1 Volts (Peak to Peak)	Brass Regulator S5-2 Volts (Peak to Peak)
Grand Piano	4.0 *	.25 *
Clavecin	2.2 *	.3 *
Harpichord	1.2 *	.1 *
Banjo	4.2 *	0
Trumpet	0	4.6
Brass Ensemble	0	3/1.8 #
French Horn	1.9	.1
Electric Guitar	3 *	.14 *
Post Horn	0	2.6
Krumet Horn	0	1.6
Oboe	0	5.2
Mandolin	3 *	.25 *
Wow	0	1.9

* At Keydown

Peak/After Decay

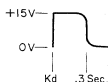
WAVEFORMS

SCHEMATIC 26

BOARD 12

1 DELAY TRIGGER

IC2 Pin 8



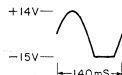
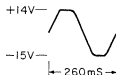
2 SOLO VIBRATO/TREMOLO OSCILLATOR

IC22 Pin 8

Connect Oscilloscope to S6-1

Solo Trem. Speed = min.

Solo Trem. Speed = max.



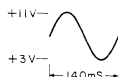
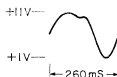
4 SLOW ATTACK DRIVER MODULATOR

IC22 Pin 14

Trem. Depth minimum = +11V

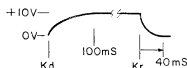
Trem. Depth max.
Trem. Speed min.

Trem. Depth max.
Trem. Speed max.



3 SLOW ATTACK DRIVER

Emitter Q5

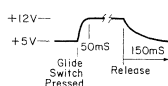
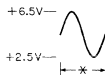


6 SOLO TUNING AND VIBRATO AMPLIFIER

IC22 Pin 7

Tremolo Depth max.

Solo Trumpet Preset On
Tremolo Depth min.

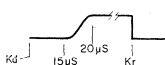


* Varies from 140mS to 260mS with Trem. Speed Control

5 KEYSER DELAY

IC31 Pin 11

Any Solo Preset On



7 SOLO MASTER OSCILLATOR

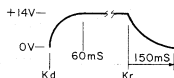
Emitter Q23



8 SOLO CLARINET DRIVER

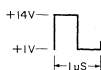
Emitter Q17

Solo Clarinet Preset On



9 DIVIDER

IC32 Pin 11



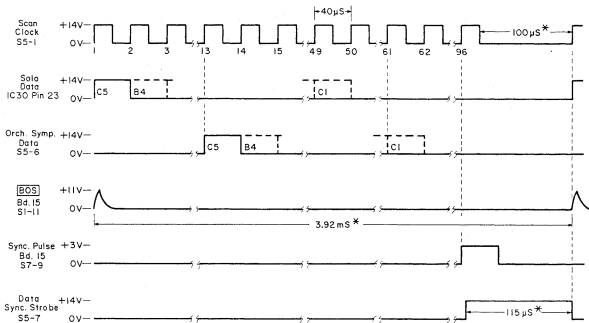
WAVEFORMS

SCHEMATIC 26 (Cont.)

BOARD 12

10 SOLO NOTE GENERATOR TIMING DIAGRAM

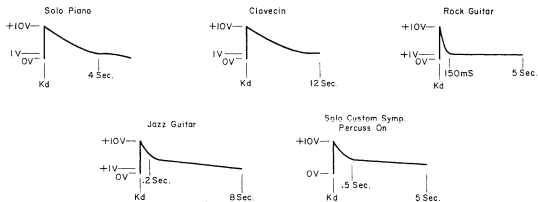
Connect **BOS** Test Point (SI-II, Board 15) to External Trigger input of oscilloscope.
 Trigger = Positive Edge Press C5 Keyswitch
 Any Solo Preset on, any Orch. Symp. Preset on.



*Or longer depending on communication time between microprocessor and SIC.

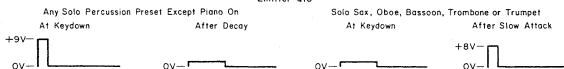
11 PERCUSSION DRIVER

Emitter Q6



12 PULSE DRIVER

Emitter Q16



WAVEFORMS

SCHEMATIC 27

BOARD 2

1 AUDIO MODULATOR

Connect Oscilloscope to IC28 Pin 8
Upper A2 Keyswitch Pressed

Solo Preset	IC28 Pin 8 Volts (Peak to Peak)	S3-8 Volts (Peak to Peak)
Piano	N/A	9*
Clavecin	N/A	5.5*
Rock Guitar	6.8*	8*
Sax	N/A	11
Oboe	N/A	8.5
Jazz Flute	5	6
Jazz Guitar	8.4*	10*
Clarinet	N/A	7
Bassoon	N/A	7.5
Trombone	10*/7.4	12.5*/9
Trumpet	12	15

* Keydown / After Decay

2 KEYING

ENVELOPE MODULATOR

Solo Trumpet Tab On

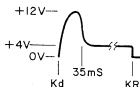
	Before Keydown	After Keydown
IC28 Pin12	-1.7VDC	+1.6VDC

BOARD 12

3 NOISE DRIVER

Emitter Q9

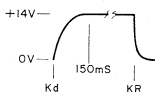
Jazz Flute Preset On



4 JAZZ FLUTE 8' DRIVER

Emitter Q10

Jazz Flute Preset On



5 FILTER ENVELOPE

TRIGGER

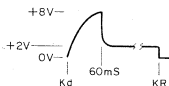
IC21 Pin 10



6 JAZZ FLUTE 4' DRIVER

Emitter Q7

Jazz Flute Preset On



7 SOLO CUSTOM SYMPHONIZER

TUNING PREAMP & DRIVER

Solo Custom Symphonizer - On

Filter	Envel.	Collector Q20		
Tune Resonance Range Attack Decay Sustain	IC23 Pin 8 VDC	VDC	Filter Follow = On	
		CI Key Pressed VDC	C5 Key Pressed VDC	
1 X 1 X X X X	+2	-12.8	-13.25	-12.7
8 X 1 X X X X	+3	-10.25	-12.7	-8.4
1 X 8 X X X X	+3	-12.7	-13.25	-12.5
1 X 8 X X X X	+4.3	-9.2	-12.5	-6.5
8 X 8 X X X X	+5.5	-8.2	-12.5	-4.8
8 X 8 X X X X	+14	-9	-11.7	-1.4
8 X 8 X X X X	+6	-7.7	-12.5	-4

1=Minimum

8=Maximum

X= Don't Care

7 FILTER TUNING PREAMP AND DRIVER

Solo Preset	IC23 Pin 8 VDC	Collector Q20 VDC
Jazz Guitar	+2.25	-12.8/-9.6*
Trombone	+1.1	-12
Trumpet	+2.5	-10.8
All Others	+14	-9

* CI Key/C5 Key Pressed

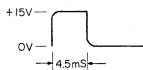
WAVEFORMS

SCHEMATIC 28

BOARD 29

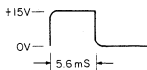
1 TOM TOM TRIGGER

IC9 Pin 11
Bosa Nova Playing



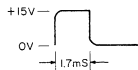
2 BASS DRUM TRIGGER

IC9 Pin 3
Bosa Nova Playing



3 SNARE DRUM TRIGGER

IC8 Pin 4
Bosa Nova Playing



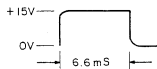
4 LOW DRUM TRIGGER

IC9 Pin 10
Bosa Nova Playing



5 GENIE MODULATOR TRIGGER

IC8 Pin 11
Bosa Nova Playing



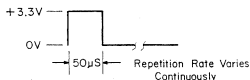
SCHEMATIC 29

BOARD 28

1 TRAP ENABLE LATCH

IC4 Pin 9

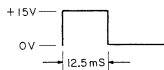
Connect Oscilloscope To SI-9



BOARD 29

2 CYMBAL TRIGGER

IC8 Pin 3
Bosa Nova Playing



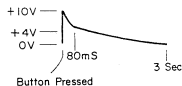
3 BRUSH TRIGGER

IC8 Pin 10
Bosa Nova Playing



4 CRASH CYMBAL DRIVER

Emitter Q9
Press Crash Cymbal Pushbutton



WAVEFORMS

SCHEMATICS 30, 31

BOARD 9

2 OUTPUT AMP VOLUME LEVELS

The following chart is representative of each of the audio circuits.

1 VOLUME REGULATOR DRIVER

Emitter Q17

Minimum Volume = -14V
Maximum Volume = -7.25V

Note: Will vary depending
on setting of Min. &
Max. Volume Adj.

1. Place all volume controls and volume tabs to full volume.
2. Connect a voltmeter to the emitter of Volume Regulator Driver Q17 (S4-7). Adjust expression pedal for reading of -7.5 VDC.
3. Press Speaker Cancel pushbutton.
4. Tabs or presets are activated one at a time.
5. Hold down the A2 Keyswitch on the upper and lower keyboards and the A Bass pedal.
6. Connect oscilloscope to appropriate pin of Socket 4 (Board 9) or Lug (Board 50).
7. Input coupling AC.
8. Voltages are approximate peak-to-peak readings $\pm 10\%$ Signal + Noise.
9. Adjust trigger level just above noise range. Noise level = $.1V \pm .05V$ P-P at Volume Regulators, $.2V \pm .1V$ P-P at Output Amplifiers (Avg).
10. For the Output Amplifiers voltage measurements of .6V or less are due to inherent bleed through of audio signal between amplifiers and are shown as zero.

		VOLUME REGULATOR BOARD 9					OUTPUT AMPLIFIERS (See Note 10) BOARD 50					
TAB OR PRESET		Chorus 1 S4-4	Flute 1 S4-3	Main S4-1	Flute 2 S4-2	Chorus 2 S4-5	Chorus 1 Lug 1	Flute 1 Lug 2	Main Lug 8	Flute 2 Lug 7	Chorus 2 Lug 9	Bass Lug 12
Upper Keyboard	Flute 8	0V	.2V	0V	.2V	0V	0V	1.5V	0V	1.5V	0V	0V
	Flute 8 w/Chorus	.15V	.2V	.1V	.2V	.15V	1V	1.5V	1V	1.5V	1V	0V
	Clarinet 16	0V	.4V	.42V	0V	0V	0V	4V	4V	0V	0V	1.1V
	Clarinet 16 w/ Main Chorus	.4V	0V	.4V	0V	.4V	3.5V	0V	3.5V	0V	3.5V	1.2V
	Accordion	0V	.3V	.3V	0V	0V	0V	3V	3V	0V	0V	1.1V
	Vibes	.13V	.42V	.44V	0V	.13V	.5V	5.5V	5V	.7V	.5V	3V
	Solo Piano	.8V*	0V	.8V*	0V	.8V*	9V*	0V	9V*	0V	9V*	5V*
	Solo Clarinet	.75V	0V	.75V	0V	.75V	6V	0V	7V	0V	6.5V	3.5V
	Orch. Gr. Piano	.5V*	1.2V*	1.3V*	1.3V*	.5V*	5V*	14V*	15V*	14V*	5V*	4V*
Lower Keyboard	Orch. Trumpet	1.2V	0V	0V	0V	1.2V	15.5V	0V	0V	0V	15.5V	1.4V
	Symp. Viola	.4V	0V	.4V	0V	.4V	4.5V	0V	4.5V	0V	4.5V	.7V
	Symp. Viola	.35V	0V	.4V	0V	.4V	3.5V	0V	3.5V	0V	3.5V	0V
	Flute 8	0V	.3V	0V	.3V	0V	0V	2.6V	0V	2.6V	0V	0V
	Flute 8 w/Chorus	.2V	.3V	.15V	.3V	.2V	1.5V	2.6V	1.5V	2.6V	1.5V	0V
	Diapason	0V	.22V	.15V	0V	0V	0V	2.8V	2.8V	0V	0V	0V
	Piano	0V	.35V	.4V	0V	0V	0V	4.2V	4.5V	0V	0V	0V
	Pedal 8	0V	0V	.6V	0V	.35V	0V	0V	3.5V	0V	2.2V	13V
	Symp. Tuba	0V	0V	2V	0V	1.3V	0V	0V	25V	0V	17V	22V
Pedal	Double Bass	.9V	.25V	.9V	.25V	.9V	7.5V	1V	7.5V	.9V	7.5V	20V

* At Keydown

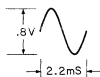
SCHEMATICS 30, 31 (Cont.)BOARD 9

3

FLUTE TO
CHORUS INPUT PREAMP

IC7 Pin 4

Flute Chorus Tab On
U. K. Flute 8 Tab On
A2 Key Pressed



4

CHORUS AUDIO MIXER

IC7 Pin 3

Connect oscilloscope to S8-4

Flute Chorus Tab On
U. K. Flute 8 Tab On
A2 Key Pressed



5

SQUELCH AMPLIFIER

IC6 Pin 4

Flute Chorus Tab On
U. K. Flute 8 Tab On
A2 Key Pressed

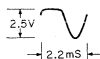


6

FULL WAVE RECTIFIER

IC6 Pin 3

Flute Chorus Tab On
U. K. Flute 8 Tab On
A2 Key Pressed

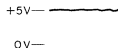


7

FILTER

IC6 Pin 12

Flute Chorus Tab On
U. K. Flute 8 Tab On
A2 Key Pressed



8

COMPARATOR

Connect voltmeter to IC6 Pin 10

Flute 8 Tab On
Flute Chorus Tab On

Normal = +13.5V

Any Upper
Keydown = -13V